

MECHANICK
EXERCISES,

O R,

The Doctrine of

Handy-works.

*Began Jan. 1. 1677. And intended to be
Monthly continued.*

By *Joseph Moxon* Hydrographer to the
Kings most Excellent Majesty.



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THE CHAMBER

EXPERIMENT

The Doctor of

THE CHAMBER

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PREFACE.

I See no more reason why the sordidness of some Workmen should be the cause of contempt upon Manual Operations than that the excellent invention of a Mill should be despised, because a blind Horse draws in it. And though the Mechanicks be by some accounted ignoble and scandalous. Yet it is very well known, that many Gentlemen in this Nation of good Rank and high Quality are conversant in Handy-Works: And other Nations exceed us in numbers of such. How pleasant and healthy this their Diversion is, their Minds and Bodies find; and how harmless and honest all sober men may judge.

That Geometry, Astronomy, Perspective, Musick, Navigation, Architecture, &c. are excellent Sciences, all that know but their very names will confess: Yet to what purpose would Geometry serve, were it not to teach Handicrafts? Or how could Astronomy be known to any perfection, but by Instruments made by Hand? What Perspective should we have to delight our sight? What Musick to ravish our Ears? What Navigation to guard and enrich our Country? Or what Architecture to defend us from the inconveniences of different Weather, without Manual Operations? Or how waste and useless would many of the Productions of this and other Countries be, were it not for Manufactures?

To dive into the Original of the Mechanicks is impossible, therefore I shall not offer at it; only I shall say, It is Rational to think that the Mechanicks began with

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Man, He being the only Creature that Nature has imposed most necessity upon to use it, endowed with greatest Reason to contrive it, and adapted with properest members (as Instruments) to perform it.

Nor is it easie to find by any Authority what part of the Mechanicks was first practised by Man; Therefore I shall wave that too; and only consider, that if we our selves were the first Men, what Branch of the Mechanicks we should first NEE D, and consequently have recourse to.

I have considered, and Answer, That without the Invention of Smithing primarily, most other Mechanick Inventions would be at a stand: The Instruments or Tools that are used in them being either made of Iron, or of some other matter form'd by the help of Iron. But pray take notice, that by Iron I also mean Steel, it being originally Iron.

Nor would I have you understand, that when I name the Mechanicks, I mean that rough and barbarous sort of working which is used by the Natives of America, and some other such Places; For, though they did indeed make Houses, Canoes, Earthen Pots, Bowes, Arrows, &c. without the help of Iron, because they had then none among them; Yet since Iron is now known to them, they leave off their old way of working without it, and betake themselves to the use of it. Nor are at this day (though now they have in part the use of Iron) their Machines made by good and ready Rules of Art; for they know neither of Rule, Square, or Compass; and what they do is done by tedious working, and he that has the best Eye at guessing, works best upon the Straight, Square, or Circle.

You may perhaps think this Preface too long for so small a Pamphlet as this; but let me tell you, It is all the

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the Preface I intend for my succeeding Exercises, if it shall please God I continue them, as I hope to do: For, having for many years been conversant in Handy-Works, and especially in those Trades wherein the chief knowledge of all Handy-Works lie, viz. Smithing, Founding, Drawing, Joynery, Turning, Engraving, Printing Books and Pictures, Globe and Map-making, Mathematical Instruments, &c. So I am willing to communicate to the Publique the knowledge I have attained to. But because the whole will be both a Work of Time and great Charge, I mean to try by the sale of some few Monthly Exercises what encouragement I may have to run through all, if I live so long, and accordingly to continue or desist.

I thought to have given these Exercises the Title of The Doctrine of Handy-crafts; But when I considered the true meaning of the word Handy-crafts, I found the Doctrine would not bear it, because Handy-craft signifies Cunning or Sleight, or Craft of the Hand, which cannot be taught by Words, but is only gain'd by Practice and Exercise: therefore I shall not undertake that with the bare reading of these Exercises any shall be able to perform these Handy-works; but I may safely tell you that these are the Rules that every one that will endeavour to perform them must follow, and that by the true observing them, he may, according to his stock of Ingenuity and Zeal in diligence, sooner or later inure his hand to the Cunning or Craft of working like a Handy-craft, and consequently be able to perform them in Time.

For the Reason aforesaid I intend to begin with Smithing, which comprehends not only the Black-Smiths Trade, but takes in all Trades which use either Forge or File, from the Anchor-Smith to the Watch-Maker; they all working by the same Rules, though not with equal exactness,

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ness, and all using the same Tools, though of several sizes from those the common Black-Smith uses, and that according to the various purposes they are applied to: And in order to it I shall first shew you how to set up a Forge, and what Tools you must use in the Black-Smiths work; then the Rules and several Circumstances of Forging till your Work come to the File: Then of the several sorts of Iron that are commonly used, and what sort is fittest for each purpose. Afterwards of Filing in general, and the Rules to be observed in it in the making of Jacks, Hindges, Screws, Clocks, Watches, &c. In which Examples you will find all other sorts of Forging or Filing work whatsoever comprehended. And lastly, as a close to Smithing I shall exercise upon Steel, and its several sorts, and how to order and temper it for its several uses, and what sort is fittest for each particular purpose, as which is fittest for Edge-Tools, which for Springs, which for Punches, &c.

Some perhaps would have thought it more Policy to have introduced these Exercises with a more curious and less Vulgar Art than that of Smithing; but I am not of their opinion; for Smithing is (in all its parts) as curious a Handy-craft as any is: Besides, it is a great Introduction to most other Handy-works, as Joynery, Turning, Founding, Printing, &c. they all (with the Smith) working upon the Straight, Square, or Circle, though with different Tools upon different Matter; and they all having dependence upon the Smiths Trade, and not the Smith upon them. But having done with Smithing, I shall, God willing, proceed to those and all other Handy-works whatsoever that work upon Geometrical Principles.

Joseph Moxon.

MECHANICK EXERCISES,

O R,

The Doctrine of *Handy-Works*.*Of Smithing in general.**Definition.*

Smithing is an Art Manual, by which an irregular lump (or several lumps) of Iron is wrought into an intended shape.

This Definition needs no explanation: Therefore I shall proceed to give you an account of the Tools a Smith uses; not but (that they being so common) I suppose you do already know them; but partly because they may require some precaution in setting them up fittest to your use, and partly because it behoves you to know the names Smiths call the several parts of them by, that when I name them in Smiths Language, as I shall oft have occasion to do in these *Exercises*, you may the easier understand them as you read them.

Of setting up a Smiths Forge.

The *Hearth*, or Fire-place of the *Forge* marked A, is to be built up from your floor with Brick, about two foot and an half, or sometimes two foot nine inches high, according to the purpose you design your *Forge* for: for if your *Forge* be intended for heavy work, your *Hearth* must lie lower than it

B

need

need be for light work, for easiness of management, and so broad as you think convenient: It may be built with hollow Arches underneath to set several things out of the way. The Back of the *Forge* is built upright to the top of the Ceiling, and inclosed over the Fire place with a *Hovel*, which ends in a *Chimney* to carry away the smoak, as B. In the back of the *Forge* against the Fire place is fixed a thick Iron plate, and a taper Pipe in it about five inches long, called a *Tewel*, (or as some call it a) *Tewel-Iron*, which Pipe comes through the back of the *Forge*, as at C. Into this taper Pipe or *Tewel* is placed the Nose or *Pipe* of the *Bellows*. The office of this *Tewel* is only to preserve the Pipe of the *Bellows*, and the back of the *Forge* about the Fire place from burning. Right against the Back is placed at about twenty inches or two foot distance the *Trough*, and reaches commonly through the whole breadth of the *Forge*, and is as broad and deep as you think good, as at D. The *Bellows* is placed behind the Back of the *Forge*, and hath as aforesaid its *Pipe* fitted into the pipe of the *Tewel*, and its lower Board fixed so that it move not upwards or downwards. At the ear of the upper *Bellows*-board is fastned a *Rope*, or sometimes a *Thong* of leather, or an Iron *Chain* or *Rod*, as E, which reaches up to the *Rocker*, and fastned there to the farther end of the *Handle*, as at F. This handle is fastned across a *Rock-staff* which moves between two Cheeks upon two Center-pins in two Sockets, as at G. So that by drawing down this *Handle* the upper board of the *Bellows* rises, and by a considerable weight set upon it sinks down again, and by this agitation performs the office of a pair of *Bellows*.

Of the Anvil.

THe shape of a Black Smiths *Anvil* I have inserted in this Figure, though it is sometimes made with a *Pike*, or *Bickern*, or *Beak-iron* at one end of it, whose use I shall shew you when I come to round hollow work. Its *Face* must be very flat, and smooth, without flaws, and so hard that a *File* will not touch it, (as Smiths say when a *File* will not cut or race it.) The upper Plain A is called the *Face*; it is commonly set upon a wooden *Block*, that it may stand very steady and solid, and about two foot high from the floor, or some times higher, according to the stature of the person that is to work at it.

Of the Tongs.

THere are two sorts of *Tongs* used by Smiths; the one the *Straight nosed Tongs*, used when your work is short and somewhat flat, and generally for all Plate Iron. The other the *Crooked nos'd Tongs*, to be used for the forging small Bars, or such thicker work as will be held between their *Chaps*. The *Chaps* are placed near the Joynt, because, that considering the length of the *Handles*, they hold the Iron faster than they would do were they placed farther from the Joynt, as in the Fig. 3, 4. A the *Chaps*, B the Joynt, C C the *Handles*.

Of the Hammer and the Sledge.

THere are several sorts of *Hammers* used by Black-Smiths; as first the *Hand-Hammer*, which is sometimes bigger or less according to the strength of the Workman, but it is a *Hammer* of such weight

that it may be weilded or govern'd with one hand at the *Anvil*. Secondly, the *Uphand Sledge*, used by under-Workmen when your work is not of the largest, yet you require help to batter or *draw it out*; they use it with both their hands before them, and seldom lift their *Hammer* higher than their Head. Thirdly, the *About Sledge*, is the biggest *Hammer* of all, and is also used by under-Workmen for the battering or *drawing out* of the largest work; and then they hold the further end of the *Handle* in both their hands and swinging the *Sledge* above their Heads, they at arms end let fall as heavy a blow as they can upon the work. There is also another *Hammer* used by them, which they call a *Riveting Hammer*: this is the smallest *Hammer* of all, and very rarely used at the *Forge*, unless your work prove very small: but upon cold Iron it is used for Riveting, or setting straight, or crooking small work. In Fig. 5. A the *Face*, B the *Pen*, C the *Eye*, D the *Handle*.

Of the Vice.

THe *Vice* must be set up very firmly that it shake not, and stand upright with its *Chaps* parallel or range with your *Work-bench*; because square filing is a great piece of good Workmanship in a Smith, and should your *Vice* not stand upright and range with the *Work-bench*, the *Chaps* pinching upon two square sides would make the top side of your work either lean towards you or from you, and consequently you filing (as a good Workman ought to do) upon the Flat or Horizontal plain of your work, would take off more of that angle or edge which rises higher than the Plain, and less off

off that edge that lies lower than the Plain; so that an Angle being higher or lower than the other, your work instead of *Square* would be *Squire-wise*, when you shall have filed all its flat sides, and that more or less according to the leaning of the *Chaps* of your *Vice*. A A the *Face*, hath its two ends lie in a straight line with the middle of its *Face* or *Plain*, B the *Chaps* must be cut with a *Bastard Cut*, and very well temper'd. C the *Screw-Pin* cut with a square strong *Worm* or thred. D the *Nut* or *Screw-Box* hath also a *Square Worm*, and is brazed into the round *Box*. E the *Spring* must be made of good Steel, and very well temper'd; where note, that the wider the two ends of the *Spring* stand asunder, the wider it throws the *Chaps* of the *Vice* open. F the *Foot*, must be straight and strong enough to bear good heavy blows upon the work screwed in the *Chaps* of the *Vice*, that it neither bow or tremble.

Of the Hand-Vice.

OF the *Hand-Vice* are two sorts, one is called the *Broad Chap't Hand-Vice*, the other the *Square Nos'd Hand-Vice*. The Office of the *Hand-Vice*, is to hold small work in that may require often turning about; it is held in the left hand, and each part of your work turned upwards successively that you shall have occasion to file with your right. The *Square Nos'd Hand-Vice* is seldom used but for filing small Globulous work, as the Heads of Pins that round off towards the edges, &c. And that because the *Chaps* do not stand shouldering in the way, but that the flat of the *File* may the better come at the edges. Their *Chaps* must be cut as the *Vice* aforesaid, and well tempered.

Of

Of the Plyers.

Plyers are of two sorts, *Flat Nos'd* and *Round Nos'd*. Their office is to hold and fasten upon all small work, and to fit it in its place. The *Round Nos'd Plyers* are used for turning or bowing Wyer or small Plate into a circular form. The *Chaps* of the *Flat Nos'd Plyers* must also be cut and temper'd as the *Chaps* of the *Vice*. A the *Nose*, B the *Chaps*, C the *Joint*, D D the *Handles*.

Of the Drill and Drill-Bow

Drills are used for the making such holes as *Punches* will not conveniently serve for, as a piece of work that hath already its shape, and must have an hole or more made in it: Here the force of a *Punch* will set your work out of order and shape, because it will both batter the surface of the Iron, and stretch its sides out: the shank of a *Key* also, or some such long hole, the *Punch* cannot strike, because the shank is not forged with substance sufficient: but the *Drill*, though your work be filed and polish't, neither batters or stretches it, but cuts a true round hole just in the point you first place it. You must have several sizes of *Drills*, according as your work may require. The shape in Fig. 6. is enough to shew the fashion of it, but it must be made of good Steel, and well temper'd. A the *Point*, A B the *Shank*, C the *Drill-barrel*; where Note, that the bigger your *Drill-barrel* is, the easier it runs about, but less swift.

And as you must be provided with several *Drills*, so you may sometimes require more than one *Drill-bow*, or at least several *Drill-strings*; the strongest strings

strings for the largest *Drills*, and the smallest strings for the smallest *Drills*: But you must remember, that whether you use a small or strong string, you keep your *Drill-bow* straining your string pretty stiff, or else your string will not carry your *Barrel* briskly about. But your string and Bow must both be accommodated to the size of your *Drill*; and if both or either be too strong, they will break or bend your *Drill*; or if too weak, they will not carry about the *Barrel* as aforesaid.

The *Drill-plate* or *Breast-plate* is only a piece of flat Iron fixt upon a flat Board, which Iron hath an hole punched a little way into it to set the blunt end of the shank of the *Drill* in when you drill a hole; Workmen instead of it commonly use the *Hammer*, into which they prick a hole a little way on the side of it, and so set the *Hammer* against their *Breast*.

Of the Screw-plate and its Taps.

THE *Screw-plate* is a plate of Steel well temper'd, with several *holes* in it, each less than other, and in those *holes* are *threads* groved inwards, into which *Groves* fit the respective *Taps* that belong to them. The *Taps* that belong to them are commonly made tapering towards the point, as Fig. 7. shews. But these tapering *Taps* will not serve for some sorts of work, as I shall shew in its proper place.

These are the most essential *Tools* used in the Black-Smiths Trade; but some accidental work may require some accidental *Tools*, which, as they may fall in, I shall give you an account of in convenient place.

Of Forging in general.

I Think it needless to tell you how to make your Fire or blow it, because they are both but Labourers work, nor how little or big it need to be, for your own reason will by the size of your work teach you that; only let me tell you the Phrase Smiths use for [Make the Fire] is *Blow up the Fire*, or sometimes, *Blow up the Coals*.

When it is burning with the Iron in it, you must with the *Slice* clap the Coals upon the outside close together to keep the heat in the body of the Fire, and as oft as you find the Fire begin to break out, clap them close again, and with the *Washer* dipt in water wet the outside of the Fire to damp the outside, as well to save Coals, as to strike the force of the Fire into the inside, that your work may *heat* the sooner. But you ought oft to draw your work a little way out of the Fire, to see how it *takes its Heat*, and quickly thrust it in again, if it be not hot enough; for each purpose your work is designed to, ought to have a proper *Heat* suitable to that purpose, as I shall shew you in the several *Heats* of Iron; for if it be too cold, it will not *feel the weight of the Hammer* (as Smiths say when it will not batter under the *Hammer*) and if it be too hot it will *Red-scar*, that is, break or crack under the *Hammer* while it is working between Hot and Cold.

Of the several Heats Smiths take of their Iron.

THere are several degrees of *Heats* Smiths take of their Iron, each according to the purpose of their work: as first, a *Blood-red Heat*. Secondly, a *White Flame Heat*. Thirdly, a *Sparkling* or *Welding Heat*.
The

The *Blood-red Heat* is used when your Iron hath already its form and size, as sometimes square Bars and Iron Plates, &c. have, but may want a little hammering to smooth it. Use then the Face of your *Hand-hammer*, and with light flat blows hammer down the irregular risings into the Body of your Iron, till it be smooth enough for the File. And Note, That it behoves a good Workman to hammer his work as true as he can; for one quarter of an hour spent at the *Forge* may save him an hours work at the *Vice*.

The *Flame* or *White Heat* is used when your Iron hath not its Form or Size, but must be forged into both; and then you must take a piece of Iron thick enough, and with the *Pen* of your *Hammer*, (or sometimes according to the size of your work, use two or three pair of Hands with *Sledges* to) batter it out, or as Workmen call it, to *Tew* or *draw it out*, till it comes to its breadth, and pretty neer its shape: And so by several *Heats*, if your work require them, frame it into Form and Size; then with the Face of your *Hammer*, smooth your work from the dents the *Pen* made, as you did with a *Blood-red Heat*.

A *Sparkling* or *Welding Heat* is only used when you *double-up* your Iron (as Smiths call it) to make it thick enough for your purpose, and so *weld* or work in the *doubling* into one another, and make it become one entire lump; or it is used when you joyn several Bars of Iron together to make them thick enough for your purpose, and work them into one Bar; or else it is used when you are to joyn or *weld* two pieces of Iron together end to end to make them long enough: but in this case you must be very quick at the *Forge*, for when your two

ends are throughout of a good *Heat*, and that the inside of the Iron be almost ready to run as well as the outside, you must very hastily snatch them both out of the Fire together, and (after you have with the edge of your *Hammer* scraped off such Scales or dirt as may hinder their incorporating) with your utmost diligence clap your right hand piece upon your left hand piece, and with all speed (least you lose some part of your good *Heat*) fall to hammering them together, and work them soundly into one another: and this if your Bars be large will require another or sometimes two or three pair of hands besides your own to do; but if it be not thoroughly *welded* at the first *Heat*, you must reiterate your *Heats* so oft till they be thoroughly *welded*; then with a *Flame Heat* (as before) shape it, and afterwards smooth it with a *Blood red Heat*. To make your Iron come the sooner to a *Welding Heat*, you must now and then with your *Hearth-staf* stir up the Fire and throw out those Cinders the Iron may have run upon, for they will never burn well, but spoil the rest of the Coals, and take a little white Sand between your Finger and your Thumb and throw upon the heating Iron, then with your Slice quickly clap the outside of your Fire down again, and with your *Washer* dipt in Water damp the outside of the Fire to keep the Heat in.

But you must take special care that your Iron *burn* not in the Fire, that is, that it do not *run* or melt, for then your Iron will be so brittle that it will not endure Forging without breaking, and so hard, that a *File* will not touch it.

Some Smiths use to strew a little white Sand upon the Face of the *Anvil* also, when they are to hammer upon a *welding Heat*; for they say it makes the Iron *weld* or incorporate the better.

If

If through mistake or ill management your Iron be too thin, or too narrow towards one of the ends; then if you have substance enough (and yet not too long) you may *Up-set* it, that is, take a *Flame Heat*, and set the heated end upright upon the *Anvil*, and hammer upon the cold end till the Heated end be beat or *up-set* into the Body of your Work. But if it be a long piece of work, and you fear its length may wrong the middle, you must hold it in your left hand, and lay it flat on the *Anvil*; but so as the heated end intended to be *up-set* may lie a little over the further side of the *Anvil*, and then with your *Hand-Hammer* in your right hand beat upon the heated end of your work, minding that every stroak you take you hold your work stiff against the *Face* of the *Hammer*. Afterwards smooth it again with a *Blood-red heat*.

If you are to Forge a *Sholder* on one or each side of your work, lay the shank of your Iron at the place where your *Sholder* must be on the edge of your *Anvil* (that edge which is most convenient to your hand) and if more *Sholders* be to be made, turn them all successively, and Hammer your Iron so, as that the shank of the Iron that lies on the flat of the *Anvil* feel as well the weight of your blows as the *Sholder* at the edge of the *Anvil*: for should you lay your blows on the edge of the *Anvil* only, it would instead of flattening the shank to make the *Sholder*, cut your work through.

Your work will sometimes require to have holes punched in it at the Forge, you must then make a *Steel Punch* to the size of the hole you are to strike, and harden the point of it without tempering, because the heat of the Iron will soften it fast enough, and sometimes too fast; but then you must re-harden it: then taking a *Blood-heat* of your Iron, or if it be very large almost a *Flame Heat*;

lay it upon your *Anvil*, and with your left hand place the point of the *Punch* where the hole must be, and with the *Hand-hammer* in your right hand punch the hole: or if your work be heavy, you may hold it in your left hand, and with your *Punch* fixed at the end of a *Hoop-stick* or some such Wood, hold the stick in your right hand, and place the point of your *Punch* on the work where the hole must be, and let another man strike till your *Punch* come pretty near the bottom of your work; which when it does, the sides of your work round about the hole will rise from the *Face* of the *Anvil* and your *Punch* will print a bunching mark upon the hole of a *Bolster*, that is a thick Iron with a hole in it, and placing your *Punch* as before strike it through. But you must note, that as oft as you see your *Punch* heat or change colour, you take it out of the hole and pop it into water to reharden it, or else it will batter in the hole you intend to strike, and not only spoil it self, but the work too, by running aside in the work. Having punched it through on the one side, turn the other side of your work, and with your Hammer set it flat and straight, and with a *Blood Heat* punch it through on the other side also: So shall that hole be fit for the *File*, if the curiosity of your purposed work cannot allow it to pass without filing. When your work is Forged do not quench it in water to cool it; but throw it down upon the *Floor* or *Hearth* to cool of it self, for the quenching it in water will harden it: as I shall shortly shew you when I come to the tempering of Steel.

Of Brazing and Soldering.

YOU may have occasion sometimes to *Braze* or *Solder* a piece of work; but this is used by Smiths only when their work is so thin or small that it will not endure

endure *Welding*. To do this take small pieces of Brasse and lay them on the place that must be Brazed, and Strew a little Glasse beaten to powder on it to make it run the sooner, and give it a *Heat* in the *Forge*, till (by sometimes drawing it a little way out of the Fire) you see the Brasse run. But if your work be so small or thin that you may fear the Iron will run as soon as the brasse, and so you loose your work in the Fire, then you must make a *Loam* of three parts Clay and one part Horse-dung, and after they are wrought and mingled very well together in your hands wrap your work with the Brasse and a little beaten Glasse upon the place to be brazed close in the *Loam*, and laying it a while upon the *Hearth* of the *Forge* to dry, put the Lump into the Fire and blow the *Bellows* to it, till you perceive it have a full *Heat*, that is, till the Lump look like a well burnt Coal of Fire: Then take it out of the Fire, and let it Cool. Afterwards break it up and take out your work.

Thus much of Forging in general. It remains now that you know what Sorts of Iron are fittest for the several uses you may have occasion to apply them to.

Of several sorts of Iron, and their proper uses.

IT is not my purpose in this place to tell you how Iron is made, I shall defer that till I come to treat of Mettals and their Refinings. Let it at present satisfy those that know it not, that Iron is by a violent Fire melted out of hard stones called *Iron-stones* of these *Iron-stones* many Countries have great plenty. But because it waists such great quantities of Wood to draw the Iron from them it will not in many places quit cost to use them. In most parts of *England* we have abundance of these *Iron-stones*. But our English Iron is generally a course sort of Iron, hard and brittle, fit for Fire-bars and other such course uses: Unless it be about the *Forrest of Dean*, and some few places more, where the Iron proves very good.

Swedish Iron is of all sorts the best we use in *England*: It is a fine tough sort of Iron, will best endure the Hammer, and is Softest to file; and therefore most coveted by Work-men to work upon.

Spanish Iron would be as good as *Swedish* Iron were it not subject to *Red-scar*, (as Work-men phrase it) that is to crack betwixt hot and cold. Therefore when it falls under your hands you must tend it more earnestly at the *Forge*. But though it be a good tough soft Iron, yet for many uses Work-men will refuse it, because it is so ill,

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and un-evenly wrought in the Bars that it costs them a great deal of labour to smooth it; But it is good for all great works that require *Welding*, as the Bodies of Anvils, Sledges, large Bell-clappers, large Pestles for Mortars, and all thick, strong Bars, &c. But it is particularly chosen by *Anchor Smiths*, because it abides the Heat better than other Iron, and when it is well wrought is toughest.

There is some Iron comes from *Holland* (though in no great quantity) but is made in *Germany*. This Iron is called *Dort Squares*, only because it comes to us from thence, and is wrought into square Bars three quarters of an inch square. It is a bad course Iron and only fit for sleight uses, as Window-Bars, Brewers-Bars, Fire-Bars, &c.

There is another sort of Iron used for making of *Wyer*, which of all other sorts is the softest and toughest: But this sort is not peculiar to any Countrey, but is indifferently made where any Iron is made, though of the worst sort, for it is the first Iron that runs from the *Stone* when it is melting, and is only preserved for the making of *Wyer*. By what hath been said, you may see that the softest and toughest Iron is the best: Therefore when you choose Iron, choose such as bows softest before it break, which is an argument of Toughness; And see it break sound within, be gray of colour like broken Lead, and free from such glittering specks you see in broken *Antimony*, having no flaws or deviations in it, for these are arguments that it is sound and well wrought at the Mill.

Of Filing in general.

THe several sorts of Files that are in common use are the *Square*, the *Flat*, the *Three Square*, the *Half Round*, the *Round*, the *Thin File*, &c. All these shapes you must have of several sizes and of several *Cuts*. You must have them of several sizes, as well because you may have several sizes of work, as for that it sometimes falls out that one piece of work may have many parts in it joyned and fitted to one another, some of them great, and others small: And you must have them of several *Cuts*, because the *Rough Tooth'd File* cuts faster than the *Bastard Tooth'd File*, the *Bastard Tooth'd File* faster than the *Fine Tooth'd File*, the *Fine Tooth'd File* faster than the *Smooth Tooth'd File*.

The *Rough* or *Course Tooth'd File* (which if it be large is called a *Rubber*) is to take out the unevenness in your work which the

Hammer

Hammer made in the Forging : the *Bastard Tooth'd File* is to take out of your work the deep cuts or file stroaks the *Rough File* made : the *Fine Tooth'd file* is to take out the cuts or file stroaks the *Bastard file* made : and the *Smooth file* is to take but those cuts or file-stroaks that the *fine file* made.

Thus you see how the *files* of several *cuts* succeed one another till your work is so smooth as it can be filed. You may make it yet smoother with *Emerick, Tripoli, &c.* But of that in its proper place, because it suits not with this Section of *Filing*.

You must take care when you use the *Rough file*, that you go very lightly over those dents the *Hammer* made in your work, unless your work be Forged somewhat of the strongest, for the dents being irregularities in your work, if you should file away as much in them as you do off the eminencies or risings, your work, whether it be straight or circular, would be as irregular as it was before you filed it : And when you file upon the prominent or rising parts of your work with your *course cut File*, you must also take care that you file them not more away than you need, for you may easily be deceived, because the *course File* cuts deep, and makes deep scratches in the work ; and before you can rake out those deep scratches with your finer cut Files, those places where the Risings were when your work was forged may become dents to your Hammer dents : Therefore file not those Risings quite so low as the dents the Hammer made, but only so low as that the scratches the *Rough file* makes may lie as low or deep in your work as the Hammer dents do ; for then, when you come with your smoother Cut Files after your *rough File* the scratches of your *rough File*, and your Hammer stroaks or dents may both come out together. But to do this with greater certainty, hold your File so that you may keep so much of the length of your File as you can to rub range or (as near range as you can) upon the length of your work : for so shall the File enter upon the second Rising on your work before it go off the first, and will slip over and not touch the dent or hollow between the two Risings, till your Risings are brought into a straight line with your hollow dent. But of this more shall be said when I come to the Practice of Filing upon several particular sorts of work.

If it be a Square Bar or such like you are to file upon, all its angles or edges must be left very sharp and straight. Therefore your *Vice* being well set up, according to foregoing Directions, you must in your filing

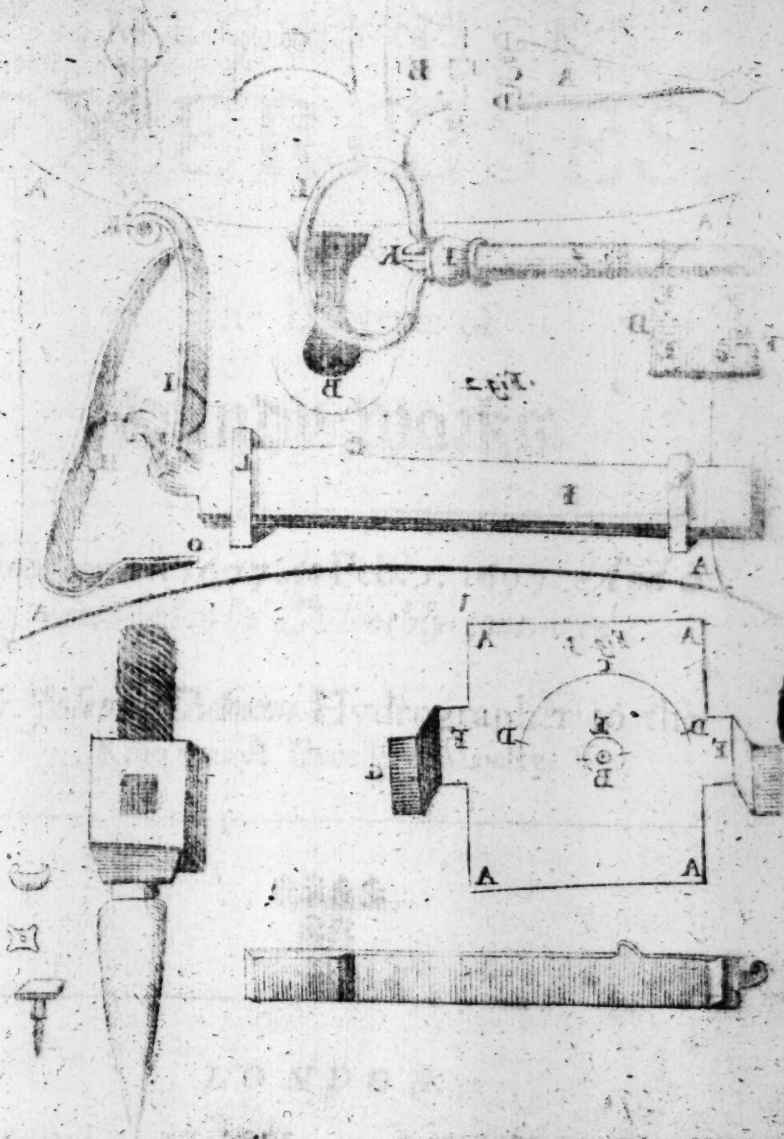
filing a thwart over the *Chaps* of the *Vice* be sure to carry both your hands you hold the *file* in truly Horizontal or flat over the work, for should you let either of your hands mount, the other would dip, and the edge of that Square it dips upon would be taken off: And should you let your hand move never so little circularly both the edges you file upon would be taken off, and the Middle of your intended flat would be left with a Rising on it. But this Hand-craft you must attain to by Practice, For it is the greatest Curiosity in filing.

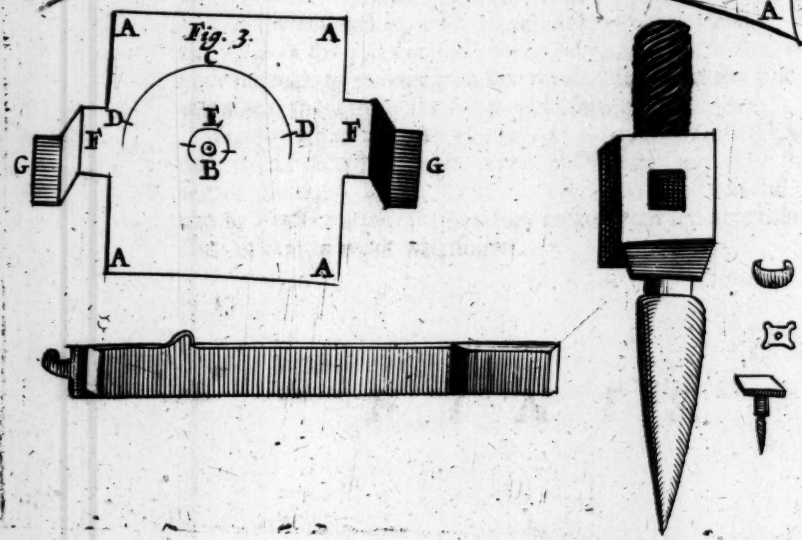
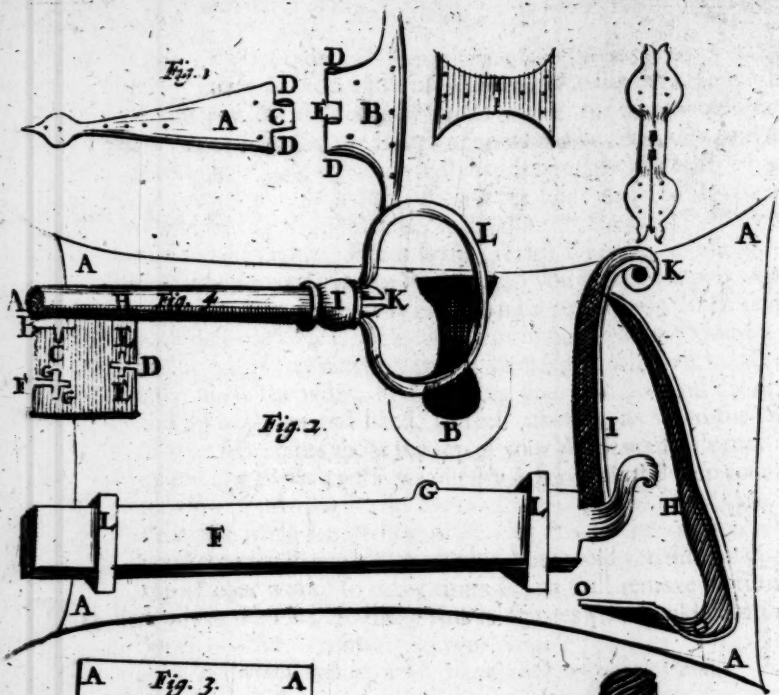
If it be a round Piece or Rod of Iron you are to file upon, what you were forbid upon Square Work you must perform on the Round, for, you must dip your Handle-hand, and mount your end hand a little, and laying pretty near the end of your File to the work, file circularly upon the work, by mounting your Handle-hand by degrees, and dipping your end-hand, in such manner, as when the Middle of your File comes about the top of your Work, your File may be flat upon it, and as you continue your stroak forwards still keep your hands moving circularly till you have finished your full stroak, that is, a stroak the whole length of the File. By this manner of circular filing, you keep your Piece or Rod round: But should you file flat upon the top of your work, so many times as you shall remove or turn your work in the *Vice*, So many flats or squares you would have in your work; which is contrary to your purpose.

When you thrust your file forwards lean heavy upon it, Because the *Teeth* of the *File* are made to cut forwards: But when you draw your file back to recover an other thrust, lift or bear the File lightly just above the work; for it cuts not coming back.

Thus much of filing in general. In my next Moneths Exercise I shall reduce these Notions to particular Practice; and shew the making of Hindges, Locks, Jacks, Screws, &c. Which skill if you can by Practice attain to, you may reckon your self able to make all sorts of Smiths work whatsoever.

F I N I S.





MECHANICK EXERCISES,

O-R,

The Doctrine of

Handy-works.

*From Jan. 1. 1677. to Feb. 1. 1677. And is
intended to be Monthly continued.*

By *Joseph Moxon* Hydrographer to the
King's most Excellent Majesty.



L O N D O N,

Printed for *Joseph Moxon* at the Sign of *Atlas* on
Ludgate-Hill, 1677.

MECHANICK
EXERCISES

The Doctrine of

Geometry

As taught by the late
William Jones

Esq. of the Middle Temple
Esq. of the Middle Temple

1735

LONDON

Printed for J. B. in the City of London
1735

MECHANICK EXERCISES,

O R,

The Doctrine of *Handy-Works*.viz. *Hinges, Locks, Keys, Screws and Nuts small and great.**Of Hinges.*

IN Fig. 1. A the *Tail*, B the *Cross*, C D D D D E the *Joynt*, D D D D the *Pin-hole*: when the *Joynt* at C on the *Tail* is pin'd into the *Joynt* at E in the *Cross*, the whole Hinge is called a *Cross Garnet*.

Hinges, if they be small (as for Cup-board doors, Boxes, &c.) are cut out of cold Plate Iron with the *Cold Chissel*, but you must mark the out-lines of your intended *Hinge*, as fig. 1. the *Cross Garnet*, either with Chalk, or else rase upon the Plate with the corner of the *Cold Chissel*, or any other hardned Steel that will scratch a bright stroke upon the Plate: And then laying the Plate flat upon the *Anvil* if the Plate be large, or upon the *Stake* if the Plate be small, take the *cold Chissel* in your left hand, and set the edge of it upon that mark or rase, and with the *Hand Hammer* in your right hand strike upon the head of the *cold Chissel*, till you cut, or rather punch the edge of the *cold Chissel* almost through the Plate in that place: I say almost through, because should you strike it quite through, the edge of the *cold Chissel* would be in danger of battering, or else breaking; for the *Face* of the *Anvil* is hardned Steel, and a light blow against its *Face* would wrong the edge of the *cold Chissel*: besides, it sometimes happens that the *Anvil* or *Stake* is not all over so hard as it should be, and then

the *cold Chissel* would cut the *Face* of the *Anvil* or *Stake*, and consequently spoil it: Therefore when the edge of the *cold Chissel* comes pretty near the bottom of the *Plate*, you must lay but light blows upon the *cold Chissel*: and yet you must strike the edge of the *cold Chissel* so near through the bottom of the *Plate*, that you may break the remaining substance asunder with your fingers, or with a pair of *Plyers*, or sometimes by pinching the *Plate* in the *Vice* with the *Cut* place close to the *Superficies* of the *Chaps* of the *Vice*; and then with your *Fingers* and *Thumb* or your whole hand wriggle it quite asunder. But having cut one breadth of the *cold Chissel* remove the edge of it forward in the *race* and cut another breadth, and so move it successively till your whole intended shape be cut out of the *Plate*.

When you cut out an *Hinge* you must leave on the length of the *Plate* A B in this Figure, *Plate* enough to lap over for the *Joynt*; I mean to *turn* or *double* about a round *Pin*, so big as you intend the *Pin* of your *Hinge* shall be, and also *Plate* enough to *weld* up on the inside of the *Hinge* below the *Pin-hole* of the *Joynt*, that the *Joynt* may be strong.

The size or diameter of the *Pin-hole* ought to be about twice the thickness of the *Plate* you make the *Hinge* of; therefore lay a *wyre* of such a diameter towards the end B,

on the *Tail-piece* athwart the *Plate* as C D, and *double* the end of the *Plate*



B, over the *wyre* to lap over it and reach as far as it can upon the end A: then hammer the *Plate* that is lap'd over the *wyre* close to the *wyre*, to make the *Pin-hole* round: but if your *Plate* be thick it will require the taking of an *Heat* to make it *Hammer* the closer to the *wyre*, and consequently make the *Pin-hole* the rounder: your work may also sometimes require to be screwed into the *Vice* with the doubled

doubled end upwards, and the bottom side of the wyre close against the *Chaps* of the *Vice*, and then to *Hammer* upon the very top of the *Pin-hole*, to round it at the end also: when you have made the *Pin-hole* round in the inside, take the *Pin C D* out of the *Pin-hole*, and put the *Joynt end* of the *Hinge* into the fire to take a *welding heat*; which when it hath, snatch it quickly out of the fire and *Hammer* or *weld* the end *B* upon the *Tail piece A* till they be incorporate together. But you must have a care that you *Hammer* not upon the plate of the *Pin-hole*, lest you stop it up or batter it: when it is well welded you must again put in the *Pin C D*, and if it will not well go into the *Pin-hole* (because you may perhaps have *Hammer'd* either upon it, or too near it, and so have somewhat closed it) you must force it in with your *Hammer*, and if it require take a *Blond heat* or a *Flame heat* of the *Joynt end*, and then force the *Pin* into the *Pin-hole* till you find the *Pin-hole* is again round within, and that the *Pin* or wyre turn evenly about within it.

Afterwards with a *Punch* of hardned Steel (as you were taught *Numb. I. fol. 11, 12.*) *punch* the *Nail holes* in the *Plate*: or if your plate be very thin, you may *punch* them with a *cold Punch*. After all, *smooth* it as well as you can with your *Hand hammer*: Take a *Blood-red heat* if your work require it; if not, *smooth* it cold; so shall the *Tail piece* be fit for the *File*. *Double* and *weld* the *Cross piece* as you did the *Tail piece*.

Having *Forg'd* your *Hinge* fit for the *File*, you must proceed to make the *Joynt*, by cutting a notch in the middle of the *Pin-hole* between *D D* on the *Cross* as at *E*, and you must cut down the ends of the *Pin-hole* on the *Tail piece* as at *D D* till the *Joynt* at *C* fit exactly into the notch in the *Cross*, and that when the *Pin* is put into the *Pin-hole D D* on the *Cross*, the *Pin-hole* in the *Tail piece* may also receive the *Pin*: then by holding the *Tail piece* in one hand and the *Cross* in the other, double the *Tail* and *Cross* towards one

another to try if they move evenly and smoothly without shaking on the *Pin*, which if they do, the *Joynt* is made, if they do not, you must examine where the fault is, and taking the *Pin* out, mend the fault in the *Joynt*.

Then *File* down all the irregularities the cold *Chissel* made on the edges of your work, and (if the curiosity of your work require it) *File* also the outer flat of your work. But *Smiths* that make quantities of *Hinges* do *brighten* them (as they call it) yet they seldom *File* them, but *grinde* them on a grinde-stone till they become *bright*, &c.

Having finished the *Joynt* put the *Pin* in again: but take care it be a little longer than the depth of the *Joynt*, because you must batter the ends of the *Pin* over the inner edges of the *Pin-hole*, that the *Pin* may not drop out when either end of the *Cross* is turned upwards.

The chiefest curiosity in the making these and (indeed all other *Hinges*) is (1) That the *Pin-hole* be exactly round and not too wide for the *Pin*. (2) That the *Joynts* are let exactly into one another, that they have no play between them, lest they shake upwards or downwards, nor yet are forced too hard into one another, lest when they are nailed on the door the *Joynt* be in danger of breaking. (3.) That the *Cross* and the *Tail* lye on the under side exactly flat, for should they warp out of flat when they are nailed on, the nails would draw the *Joynt* awry, and not only make it move hard and unevenly, but by oft opening and shutting break the *Joynt*. (4.) If your work be intended to be curious, the true *square filing* the upper side as you were taught *Numb. I. fol. 14, 15, 16.* is a great ornament.

a *Smiths* call all *Chissels* they use upon cold Iron, *Cold Chissels*.

b. The *Stake* is a small *Anvil* which either stands upon a broad Iron foot or *Basis* on the *work-bench*, to remove as occasion offers; or else it hath a strong Iron *spike* at the bottom, which Iron *spike* is let into some certain place

place of the *work-bench* not to be removed. Its office is to set small cold work straight upon, or to cut or punch upon with the *cold Chissel* or *cold Punch*.

Smiths call all *Punches* they use upon cold Iron *cold Punches*.

If the *Hinge* you are to make be large, and plate Iron is not strong enough for it, you must *Forge* it out of flat bar iron, as you were taught *Numb. I. fol. 8. to 13.*

The manner of working *duff-sails*, and *side-hinges*, &c. is (the shape considered) in all respects the same I have here shewed you in *Craft-Garnets*: But in these or others you may if your work require curiosity, instead of *doubling* for the *Joynt*, *Forge* the *Round* for the *Joynt* of full Iron, and afterwards *drill* a hole through it, for the *Pin-hole*; and by curious *filig* work them so true into one another, that both sides of the *Hinge* shall seem but one piece: as I shall shew more at large, when I come to the making *Compasses*, and other *Joynts* for *Mathematical Instruments*.

Of Locks and Keys.

AS there are *Locks* for several purposes, as *Sweet-door Locks*, called *Stock-locks*, *Chamber-door Locks*, called *Spring-locks*, *Cupboard Locks*, *Chest Locks*, *Trunk Locks*, *Pad-locks*, &c. So are there several Inventions in *Locks*, I mean in the making and contriving their *Wards* or *Guards*. But these contrivances being almost innumerable, according to the various fancies of men, shall be referred to another time to discourse: And I shall now shew you the working of a *Spring-lock*, which when you know how to do, your Fancy may play with inventions as you best like.

In Fig. 2. A A A A the *Main-plate*, B C the *Key-hole*, E D E the *Top hoop*, E E *Cross wards*, F the *Bolt*, G the *Bolt toe*, or *Bolt Nab*, H the *Draw-back spring*, I the *Tumbler*, K the *Pin of the Tumbler*, L L the *Staples*.

In Fig. 3. A A A A the *Cover-plate*, B the *Pin*, D C D the *Main-*
E

Main-ward, DD *Cross wards*, E the *Step ward*, or *Dap ward*.

In *Fig. 4.* A the *Pin-hole*, B the *Step or Dap ward*, C the *Hook-ward*, D the *Middle or Main-Cross-ward*, E E the *Cross-ward*, F the *Main-ward*, GG *Cross-ward*, H the *Shank*, I the *Pos or Bead*, K the *Bow-ward*, L the *Bow*, BCDEEFGG the *Bit*.

First, cut out of an Iron plate with a *Cold Chissel* the size and shape of the *Main-plate*, as you were taught to cut the *Cross* and *Tail-piece* of the *cross garnes*: then consider what depth you intend the *Bit* of the *Key* shall have, and set that depth off on the *Main-plate* by leaving about half an inch of plate between the bottom of the *Key-hole*, and the lower edge of the *Main-plate*, as at ^c (or more or less according to the size of the *Lock*.) Then measure with a pair of *Compasses* between the bottom of the *Bit* and the *Centre* of your *Key* (or your intended *Key*) and set that distance off from C to B near the middle between the two ends of the *Main-plate*, and with the ^a *Prick-punch* make there a mark to set one foot of your *Compasses* in, then opening your *Compasses* to the middle of the *Bit* of your intended *Key*, as to D, describe the arch E D E for the true place the *Top-hoop* must stand on.

Then cut out another piece of plate as AAAA in *fig. 3.* for a *cover-plate* with two pieces one on each side long enough to make *Studs* of to turn downwards, and then outward again as FFGG that the *cover-plate* may stand off the *Main-plate* the breadth of the *Bit* of the *Key*: and at the two ends of these *Studs* punch holes as GG to rivet the *cover-plate* upon the *Main-plate*. In the middle of this Plate make the *Centre*, as at B, then open your *Compasses* to three quarters the length of the *Bit*, and half the diameter of the *Shank* of the *Key*, and placing one foot in the point B, describe with the other foot the arch DCD for the

the true place of the *Main-ward*, then set your *Compasses* to a little more than half the diameter of the *shank*, and place one *foot* (as before) in the *centre* B, and with the other *foot* describe the small arch E for the true place the *step-ward*, or (as some call it) the *Dap-ward* must stand: So have you the true places of all the *wards* for an ordinary *Spring-lock*: you may (if the depth of your *Bit* will bear it) put more *wards* into your plates. But you must note, that the more *wards* you put in, the weaker you make your *Key*: because that to every *ward* on the Plates you must make a slit or *ward* in the *Bit* of the *Key*; and the more *wards* you make, the weaker the Iron of the *Bit* will be; and then if the *Bolt* shoot not easily backwards or forwards the *Bit* may be in danger of breaking.

Having marked on your Plates the places of all your *wards* you must take thin Iron plate, and with *Hammering* and *Filing* make them both ^b *Hammer-hard*, and of equal thickness all the way. Then *file* one edge very straight by laying a *straight ruler* just within the edge of it, and drawing or racing with a point of hardened Steel a bright line by the side of the *Ruler*: *file* away the edge of the Plate to that line, then draw (as before) another straight line parallel to the first straight line, or which is all one, parallel to the filed edge, just of the breadth you intend the *wards* shall be, and file it as before, only, you must leave two, or sometimes three *studs* upon this Plate, one near each end, and the other in the middle, to *rivet* into the *Main-plate*, to keep the *ward* fixt in its place. Therefore you must take care when you elect this thin piece of Plate, that it be broad enough for the *ward* and these *Studs* too. Then laying the Plate athwart the *Pike* of the *Bickern* hold your hand even with the face of the *Bickern*, and hammer this Plate down somewhat by the side of the *Pike*, and by degrees you may (with care taken) bring it unto a Circular form, just of the size of that Circle you described on the *Main-plate*; which

when you have done, you must apply this *ward* to the Circle you described on the *Main-plate*, setting it in the position you intend it shall be fixed, and marking with a Steel point where the *studs* stand upon that Circle, in those marks *punch* holes to *rivet* the *studs* to. Work so by all the other *wards*.

If you have a *Pin* to the *Lock*, *Punch* a hole through the *Centre* on the *cover-plate*, somewhat smaller than the *wyre* you are to make your *Pin* of, because you may then *file* one end of the *Pin* away to a *shank*, which must fit the smaller hole on the *Plate*, and the whole thickness of the *Pin* will be a *shoulder*, which will keep the *Pin* steady in the *centre-hole* of the *Plate*, when the *Pin* is *rivetted* into the *Plate*. But because there is some skill to be used in *Rivetting*, I shall before I proceed any further teach you

The manner of Rivetting.

Rivetting is to batter the edges of a *shank* over a *Plate* or other Iron the *shank* is let into, so as the *Plate* or other Iron may be clinched close and fixed between the battering at the end of the *shank* and the *shoulder*. So that

When you *rivet* a *Pin* into a hole, your *Pin* must have a *shoulder* to it thicker than the hole is wide, that the *shoulder* slip not through the hole as well as the *shank*: But the *shank* of the *Pin* must be exactly of the size of the hole the *shank* must be *rivetted* into, and somewhat longer than the *Plate* is thick: *file* the end of the *shank* flat, so shall the edges of the end the easier batter over the *Plate*: then put your *shank* into the hole wherein it is to be *rivetted*, but be sure you force the *shank* close up to the *shoulder*: then turn the top of this *shoulder* downwards (*Plate* and all) upon your *stake*, but lay it so as that the *shoulder* lye solid and the *shank* at the same time stand directly upright, and with your left hand keep your work bearing hard upon the flat or face of the *stake*: Then holding your *Hammer* in your right hand, hold the edge

edge of the *face* of it dripping a slope from the right hand outwards, & lay pretty light blows upon the edge of the end of the *shank*, turning with your left hand your work round to the *face* of the *Hammer*, till you have battered the edges of the *shank* quite round about: But this is seldom done with once turning your work about; therefore you may thus work it round till you find it is pretty well *rivett*ed: then lay heavier blows upon it, sometimes with the *face*, sometimes with the *pen* of the *Hammer*, till the end of the *shank* is battered effectually over the plate.

One main Consideration in *Rivetting* is, that the *Pin* you *rivet* in, stand upright to the plate, or other iron you *rivet* it upon: for if it do not stand upright you will be forced to set it upright after it is *rivett*ed, either in the *Vice* or with your *Hammer*, and that may, if your Plate be thin, bow it, or if it be thick break the *shank* or else the *shoulder* of your *rivet*, and so you lose your labour, and sometimes spoil your work.

Another Consideration is, that, when you *rivet* a *Pin* to any Plate, and you fear it may afterwards twist about by some force that may be offered it, you must, to provide against this danger, *file* the *shank* you intend to *rivet* either square or triangular, and make the hole in the Plate you *rivet* it into of the same size and form, and then *rivet* in the *shank* as before. There are two ways to make your hole square or triangular, one is by *filing* it into these forms when it is first punched round; the other by making a *Punch* of Steel of the size and shape of the *shank* you are to *rivet*; and *punching* that *Punch* into the Plate, make the same form.

Now to return where I left off. The *Pins* or *shanks* of these *wards* must be made of a long square form, because, (the Plates of these *wards* being thin) should you make them no broader than the Plate is thick, the *studs* or *shanks* would be too weak to hold the *wards*, therefore you must make the *rivetting shank* three or four times, or sometimes more, as broad as the Plate is thick, and then *rivet* them in, as you were taught just now. Then

Then place the *Cover-plate* upon the *Main-plate*, so as the *Centre* of the *Cover-plate* may stand directly over and against the *centre* of the *Main-plate*, and make marks through the hole GG, of the *studs* of the *cover-plate* upon the *main-plate* and on those marks punch holes, and fit two *pins* into them to fasten the *cover-plate* on to the *main-plate*, but you must not yet *rivet* them down till the *key-hole* be made, because this *cover-plate* would then stop the progress of the *file* through the *Main-plate*. When you have placed the *cover-plate* upon the *main-plate*, and fitted it on with *Pins*, so, as you may take it off and put it on again as your work may require, you must *punch* the *key-hole*, or rather *drill* two holes close by one another, if the *key-hole* falls near the *wards*, because *punching* may be apt to set the *wards* out of form, and with small *files*, file the two holes into one another to make the hole big enough to come at with bigger *files*, and then file your *key-hole* to your intended size and shape.

The *key-hole* being finished, Forge your *Key*, as you were taught, Numb. I. fol. 8. and if your *Key* is to have a *Pin-hole*, drill the hole in the middle of the end of the *shank*, then file the *wards* or *flits* in the *Bit* with thin *files* at the same distances from the middle of the *Pin-hole* in the end of the *shank* (which is the same *centre* which was made before in the *Main-plate* on the *Cover-plate*) which you placed the *wards* at from the *centre* of the *Main* and *cover-plate*. But before you file these *wards* too deep into the *bit* of the *Key*, make trials, by putting the *bit* into the *key-hole*, whether the *wards* in the *bit* will agree with the *wards* on the *Plates*, which if they do, you may boldly cut them to the depth of the *wards* on the *Plates*; if not, you must alter your course till they do: but you must take great care in cutting the *wards* down straight and square to the sides of the *bit*; for if they be not cut down straight, the *wards* on the *Plates* will not fall in with the *wards* in the *bit* of the *Key*; and if they be not square to the sides of the *bit*, the

bit will not only be weaker than it need be, but it will shew unhandſomely, and like a botch to the eye.

The *Croſs* and *Hook-wards* is made, or at leaſt entered, at the *Forge*, when the *Iron* hath a *blund* or almoſt a *ſome heat*, with a thin *Chiffel* as you were taught Numb. I. fol. 11, 12. But you muſt take care that your *Chiffel* be neither too thick or too broad, for this punching of *wards* is only to give the thin *files* entrance to work; which entrance when you have, you may eaſily *file* your *Croſs* or *Hook-wards* wider, or deeper as your work may require: But if your *Chiffel* be too broad or too thick, it will make the *wards* in the *Bit* too long or too wide, and then (as I ſaid before,) the *Bit* of your *Key* will prove weaker than it needs to be.

Having made the *wards* on the *Plate* and in the *Bit* of the *key*, you muſt *Forge* the *Bolt* of a conſiderable ſubſtance, thick and ſquare at the end that ſhoots into the *ſtaple* in the frame of the door, that it may be ſtrong enough to guard the whole door: But the reſt of the *Bolt* that lies between the two *Staples* on the *Main-plate* may be made very thin inwards, that is the ſide that lies towards the *Main-plate*, which becauſe it cannot be ſeen when the *bolt* is fixed upon the *Plate*, I have made a *Figure* of it, and turned the inſide to view, as in *fig. 4.* where you may ſee that the end *A* hath a conſiderable ſubſtance of *Iron* to guard the whole door as aforeſaid, and *B* is a ſquare *ſtud* which doth as well keep the outſide flat of the *bolt* on the range, as ſerve for a *ſtud* for the *ſpring H* in *fig. 2.* to prefs hard againſt, and ſhoot the *Bolt* forwards: This *Bolt* muſt be wrought ſtraight on all its ſides, except the *Topſide*, which muſt be wrought ſtraight only as far as the *ſhoulder G* called the *Tee* or *Nab* of the *Bolt*, which riſes as you ſee in the *Figure* conſiderably high above the ſtraight on the *Top* of the *Bolt*: The office of this *Nab* is to receive the bottom of the *Bit* of the *key* when in turning it about it ſhoots the *Bolt* backward or forwards.

Having *Forged* and *filed* the *Bolt*, you muſt fit the hollow *ſide*

side of it towards the *Main-plate*, at that distance from the *Key-hole*, that when the *key* is put into the *key-hole* and turned towards the *Bolt*, the bottom of the *Bit* may fall almost to the bottom of the *Nab*, and shoot the *Bolt* back so much as it needs enter the *Staple* in the door frame. And having found this true place for the *Bolt*, you must with square *Staples*, just fit to contain the *Bolt* with an easie play, fasten these *staples* by rivetting them with the *Bolt* within them, one near the *Bolt* end, the other near the *Nab* end, as at N N to the *Main-plate*.

Then punch a pretty wide hole in the *Main-plate*, as at K, to receive a strong *Pin*, and file a *shoulder* to the *shank* of the *Pin* that goes into the *Plate*: This *Pin* is called the *Pin of the Tumbler*. The *Tumbler* is marked I, which is a long piece of *Iron* with a round hole at the Top to fit the *Pin* of the *Tumbler* into, that it may move upon it as on a *Joint*, and it hath an *Hook* returning at the other end of it, to fall into the breach of the *Bolt*, and by the *spring* H forces the *Bolt* forwards when it is shot back with the *key*. This *spring* is made of *Steel*, and afterwards temper'd (as I shall shew you in proper place:) It is fixed at the bottom of the *Main-plate*, by two small *shanks* proceeding from that edge of the *spring* that lies against the *Main-plate* as at O O: These *shanks* are to be rivetted (as you were taught even now) on the other side of the *Main-plate*.

All things being thus fitted punch an hole on each corner of the *Main-plate* for *Nails* to enter that must nail the *Lock* to the *Door*. Or if you intend to screw your *Lock* on the *Door* you must make wide holes, big enough to receive the *shank* of the *Screw*. Last of all Rivet down your *cover-plate* to the *Main-plate*, and file your *key*, and polish it too if you will, so shall the *Lock* and *key* be finished.

^a A *Prick-punch* is a piece of temper'd *Steel* with a round point at one end, to prick a round mark in Cold iron.

^b *Hammer-hard* is when you harden *Iron* or *Steel* with much *Hammering* on it.

The

The making of Screws and Nuts.

THe *shank* of the *Screw* for *Doors* and many other purposes must be Forged square near the *Head*, because it must be let into a square hole that it may not twist about when the *Nut* is turned about hard upon the *screw-pin*. Therefore take a square bar or rod of *Iron* as near the size of the *Head* of the *screw-pin* as you can, and taking a *flame-heat* of it; lay so much of this Bar as you intend for the length of the *shank*, with one square side flat, upon the hither side of the *Anvil*, and hammer it down to your intended thickness: But have a care you do not strike your *Iron* on this side the edge of the *Anvil*, lest you cut the *Iron*, as I told you *Numb. I. fol. 11.* Thus at once you will have two sides of your *shank* forged; the under-side made by the *Anvil*, and the upper side beaten flat with the *Hammer*: The *Head* will be in the Main Rod of *Iron*, then if your iron grows cold, give it another *heat*, and lay one of the un-wrought sides upon the hither side of the *Anvil* just to the *head*, and hammer that down as before, so shall the two other square sides be made: then hammer down the corners of so much of this *shank* as you intend for the *screw-pin*, and round it as near as you can with the *hammer*; set then the *Gibbet* to the thickness you intend the *head* shall have, and strike it about half through, then turn the sides successively, and cut each side also half through till it be quite cut off. If the *shoulder* be not square enough, hold it in your *square-nos'd Tongs*, and take another *heat*, and with speed (lest your work cool) screw the *shank* into the *Vice*, so as the *shoulder* may fall flat upon the *Chaps* of the *Vice*, then hammer upon the *head* and square the *shoulder* on two sides, do the like for squaring the other two sides. This was in part taught you before, in *Numb. I. fol. 11.* but because the cutting this iron Rod or bar, just above the *shoulder* makes the *head*, and

for that I did not mention it there, I thought fit (since the purpose required it) to do it here: The Forging of the *Nuts* are taught before, *Numb. I. fol. 11, 12.*

Having Forged and Filed your *shank* square, and the head either square or round, as you intend it shall be, file also the *screw-pin*, from the rifings and dents left at the Forge; and file it a little tapering towards the end, that it may enter the *screw-plate*: The Rule how much it must be tapering is this, consider how deep the inner grooves of the *screw-plate* lye in the outer threads, and file the end of the *screw-pin* so much smaller than the rest of the *screw-pin*, for the outer threads of the *screw-plate* must make the Grooves on the *screw-pin*, and the Grooves in the *screw-plate* will make the threads on the *screw-pin*. Having fitted your self with a hole in your *screw-plate* (that is such a hole whose diameter of the hollow grooves shall be equal to the diameter of the *screw-pin*, but not such an hole whose diameter of the outer threads shall be equal to the diameter of the *screw-pin*, for then the *screw-plate* will indeed turn about the *screw-pin*, but not cut any grooves or threads in it) screw the *shank* with the head down-wards in the *Vice*, so as that the *screw-pin* may stand directly upright, and take the handle of the *screw-plate* in your right hand, and lay that hole flat upon the *screw-pin*, and press it pretty hard down over it, and turn the *screw-plate* evenly about with its handle towards you, from the right towards the left hand, so shall the outer threads of the *screw-plate* cut grooves into the *screw-pin*, and the substance of the Iron on the *screw-pin* will fill up the grooves of the *screw-plate*, and be a thread upon the *screw-pin*. But take this for caution, that as I told you you must not make your *screw-pin* too small, because the *screw-plate* will not then cut it, so if you make it too big (if it do enter the *screw-plate* where it is taper) it will endanger the breaking it, or, if it do not break it, yet the *screw-plate* will after it gets a little below the tapering

go no further, but work and wear off the *thread* again it made about the tapering.

As the *hole* of the *screw-plate* must be fitted to the *screw-pin*, so must the *screw-tap*, that makes the *Screw* in the *Nut*, be fitted to the round *hole* of the *Nut*, but that *Tap* must be of the same size of your *screw-pin* too, which you may try by the same *hole* of the *screw-plate* you made the *screw-pin* with. Screw the *Nut* in the *Vice* directly flat, that the *hole* may stand upright, and put the *screw-tap* upright into the *hole*: then if your *screw-tap* have an *handle*, turn it by the *handle* hard round in the *hole*, so will the *screw-tap* work it self into the *hole*, and make *grooves* in it to fit the *threads* of the *screw-pin*. But if the *screw-tap* have no *handle*, then it hath its upper end filed to a long square, to fit into an hollow square, made near the *handle* of the *screw-plate*: Put that long square hole over the long square on the top of the *tap*, and then by turning about the *screw-plate*, you will also turn about the *tap* in the *hole* and make *grooves* and *threads* in the *Nut*.

But though small *Screws* are made with *screw-plates*, yet great *Screws*, such as are for *Vices*, *Hot-Presses*, *Printing-Presses*, &c. are not made with *Screw-plates*, but must be cut out of the main iron, with heavy blows upon a *Gold-Chissel*: The manner of making them is as follows.

The Rules and manner of cutting Worms upon great Screws.

THE *Threads* of *Screws* when they are bigger than can be made in *Screw-plates* are called *Wormes*. They consist in length, breadth and depth: the length of a *Worm* begins at one end of the *Spindle* and ends at the other: the breadth of the *Worm* is contained between any two *Grooves* on the *Spindle*, viz. the upper and under *Groove* of the *Worm* in every part of the *Spindle*: The depth of the *Worm* is cut into the diameter of the *Spindle*, viz. the depth between

the outside of the *worm* and the bottom of the *Groove*.

Consider therefore the diameter of the *Spindle*, and allow about one fifth part of it for the breadth of a *Worm* and *Groove* together. This fifth part must be divided into two parts, but not two equal parts, the biggest part for the width of the *Groove*, between *Worm* and *Worm*, and the lesser part of the breadth of the *Worm* between *Groove* and *Groove*: You ought to make the *Groove* wider than the *Worm* is broad, because the *Worm* being cut out of the same intire piece with the *spindle*, will be as strong as the *Worm* in the *Nut*, though the *Worm* on the *spindle* be smaller, for you cannot come at the *Worm* in the *Nut* to cut it with *files* as you may the *spindle*, and therefore you must either *turn up* a rod of iron to twist round about the *grooves* on the *spindle*, and then take it off and *braz*e it into the *Nut*, or else you must Cast a *Nut* of *Brass* upon the *spindle*, which will neither way be so strong as the *Worm* cut out of the whole Iron; by so much as *Brass* is a weaker metal than Iron, and therefore it is that you ought to allow the *Worm* in the *Nut* a greater breadth than the *Worm* on the *spindle*, that the strength of both may as near as you can be equalized: for both being put to equal force ought to have equal strength.

Having considered what breadth the *Worm* on the *spindle* shall have, take a small thin plate of *Brass* or *Iron*, and *file* a square notch at the end of it, just so wide and so deep as your *Worm* is to be broad and deep, and *file* the sides of the plate that this notch stands between just to the width of the *Groove*. This plate must be a gage to *file* your *Worm* and *Groove* to equal breadth by: then draw a straight and upright line the whole length of the *spindle*, divide from this line the Circumference of the whole *spindle* into eight equal parts, and through those divisions draw seven lines more parallel to the first line: Then open your *Compasses* just to the breadth of one *Worm* and one *Groove*,
and

and set off that distance so oft as you can, from the one end of the *spindle* to the other (but I should first have told you that the end of your *spindle* must be truly square to the outside) and with a *Prick-punch* make a mark to every setting off on that line, do the like to all the other straight upright lines. Note that you may choose any of these eight upright lines for the first, and make the next towards your left hand, the second (but then the first must stand towards you) and the next that, the third, and so on. And the top mark of every one of these upright straight lines shall be called the first mark, the next under that the second mark, the third the third mark, and so downwards in order and number.

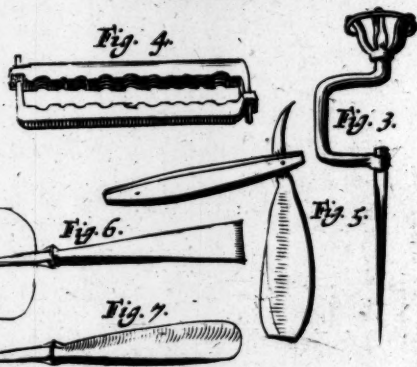
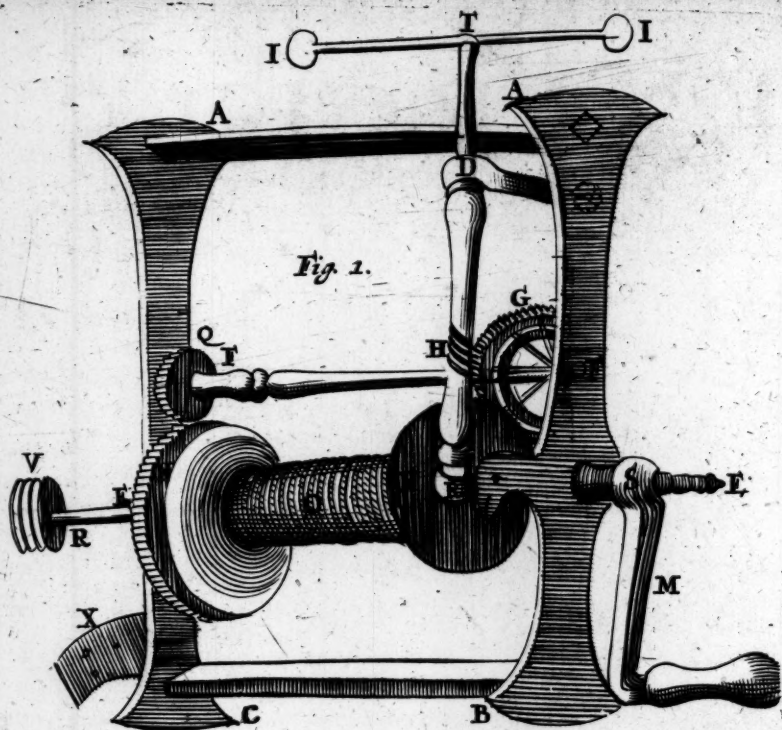
Having marked one of these eight lines at the top of the *spindle* to begin the winding of the *Worm* at, with a black lead Pencil draw a line from that mark to the second mark on the next upright line towards the left hand, from thence continue drawing on with your Pencil to the third mark, on the third upright line, draw on still to the fourth mark on the fourth upright line, and so onwards till you have drawn over the eight straight lines, which when you have done you must still continue on drawing downwards to each lower mark on each successive upright line, till you have drawn your *Worm* from end to end. Then examine as well as you can by your Eye, whether the *Worm* you have carried on from mark to mark, do not break into Angles, which if it do any where you must mend it in that place. Then with the edge of an *half round file*, file a small line in that black lead line, and be sure that the line you are filing run exactly through all the marks that the black-lead Pencil should have run through (if it did not for want of good guidance of hand) This small line is only for a guide to cut the *Groove* down by: for the making a Screw, is indeed nothing else but the cutting the *Groove* down, for then the *Worm* remains: But you must not file in this small line, but leave it as a guide

guide to lye on the middle of the *Worm* (as I said before). Therefore to cut down the *Groove*, take a *flat file* somewhat thinner than you intend the *Groove* shall be wide; *viz.* about the thickness of the breadth of the *Worm*. The reason why you should not offer to cut the *Grooves* to their full width at the first, is, because your hand may carry the *file* somewhat awry, and should your *file* be as thick as the *Groove* is wide, you could not smooth the irregularities out without making the *Worm* narrower than you intended it: with this *file* therefore file in the middle between two fine lines cut by the *half-round file*, till you have filed the *spindle* from end to end, so shall the *Worm* remain. But you must not expect that though the *Groove* be cut, it is therefore finished, for you must now begin to use the thin plate gage, and try, first whether the *Worm* have equal breadth all the way: secondly, whether the *Groove* have equal breadth all the way: and thirdly, whether the *Groove* have equal depth all the way; and where ever you find the *Worm* too broad, you must file it thinner, and where the *Groove* is not deep enough, file it deeper: therefore in cutting down the *Groove* you may observe, that if at first you file the *Worm* ne'er so little too narrow, or the *Groove* ne'er so little too deep, you shall have all the rest of the *Worm* or *Groove* to file over again, because the whole *Worm* must be wrought to the breadth of the smallest part of it, and the whole *Groove* to the depth of the deepest place all the way, especially if the *Nut* be to be *Cast* in *Brass* upon the *spindle*; because the Metal running close to the *spindle* will bind on that place and not come off it: but if the *Nut* be not to be *cast* in *Brass*, but only hath a *Worm* braz'd into it, this niceness is not so absolutely necessary, because that *Worm* is first *turned up* and bowed into the *Grooves* of the *spindle*, and you may try that before it is *braz'd* into the *Nut*, and if it go not well about, you may mend it either by *hammering* or *filing* or both.

The manner of *Casting* the *Nut* upon the *Spindle*, I shall shew when I come to the *Casting of Metals*, and the manner of *Brazing* hath been taught already, *Numb. I. fol. 12, 13.*

If your *spindle* is to have three or four *Worms* winding about it, as *Coyning-Presses* and *Printing-Presses* have, that they may come quickly down, and fly back of themselves, you must divide the Circumference into three or four equal parts, and having straight upright lines, drawn as before, begin a *Worm* at each of those three or four divisions on the Circumference, and having considered the breadth of your *Worm*, and width of your *Groove*, measure that width so oft as you can on all the upright lines, and making marks on those, at each setting off draw as before, a line from the end of the *spindle*, on the first upright line to the mark below it, which is the second mark on the second upright line. from thence to the third mark on the third upright line, and so on to the other end of the *spindle*. Having drawn the first *Worm*, work the other *Worms* as this.

Thus much may at present suffice for *great Screws*: when I come to exercise upon *Printing*, I shall be more copious, on Rules for *Printing-Presses*.



MECHANICK
EXERCISES,

O R,
The Doctrine of
Handy-works,

*From Feb. 1. 1677. to March 1. 1677. And
is intended to be Monthly continued.*

By *Joseph Moxon* Hydrographer to the
King's most Excellent Majesty.



LONDON,

Printed for *Joseph Moxon* at the Sign of *Atlas* on
Ludgate-Hill. 1677.

MECHANICK EXERCISES

OR

The Doctrine of

Geometry

is intended to be continued

King's most Excellent Majesty

LONDON

Printed for Joseph Stansby at the Sign of the Sun in St. Dunstons Church-yard

MECHANICK EXERCISES,

O R,

The Doctrine of *Handy-Works*.

Viz. *The making of Jacks, and Bullet Molds, the twisting of Iron, and Case hardning it, with the use of some Tools not treated of before: Also of the several sorts of Steel, the manner Softening, Hardning, and tempering them.*

of Jacks.

Fig 1. is called a *Worm-Jack*. A B the *Fore-side*, A C the *Back-side*, A A the *Top-peece*, B C the *Bottom-peece*, altogether the *Jack-frame*, E E K the *Main Spindle*, N O N the *Main-wheel and Barrel*, O the *Barrel*, D the *Wind-up-peece*, fastned into the *Barrel*, F F the *Worm-wheel-Spindle*, G the *Worm-wheel*, Q the *Worm-Nut*, H the *Worm*, R the *Stud of the Worm-Spindle*, D the *Worm-loop*, L the *Wind-up-peece*, M the *Winch, or Winder, or Handle*, the *Iron part* is the *Winder*, the *Wood* the *Handle*, S the *Eye of the Winder*, I I the *Fly*, T the *Socket of the Fly*, V the *Struck-wheel*, X the *Staves, or Back-fastnings*.

First you are to forge the *Jack-frame*, and on the left side of the *Fore side* a *Shank* for the *Stud of the Worm Spindle*, as you were taught, *Numb. I. fol. 8, 9, 10, 11, 12.* and then file it, as you were taught, *Numb. I. fol. 14, 15, 16.*

The *Top and Bottom peeces* are let into square holes at the ends

ends of the *Fore* and *Backsides*. But you must Forge the *Top* and *Bottom peeces* with two small Squares towards the ends of them, and two round ends for *Screw pins*, beyond those squares. The small squares are to be fitted into square holes in the *Fore* and *Backsides*, and the round *Screw pins* are to make *Screws* of, to which a square *Nut* is to be fitted to draw the *Top* and *Bottom peeces* close and right up to the insides of the *Fore* and *Backsides*. The manner of filing of these square ends you were in part taught, *Num. I. fol. 15, 16.* and *Num. II. fol. 29.* but another way is by trying your work with an Instrument called by *Work-men a Square*, as you see described in this figure.

Of the Square and it's Use.

The sides ABC are called the *Outer Square*: the sides DEF the *Inner Square*. Its use is thus, if your work (as in this case) be an outer square you must use the *inner Square* DEF to try it by: applying either the side ED, or DF (but suppose the side ED) to one of the sides of your work (choose the flattest and truest wrought) if none of the sides be flat, make one of them flat, as you were taught, *Numb. I. fol. 15, 16.* if then you find the side DF of your *Square* lye all the way even upon the adjoining side of your work, you may conclude those sides are square: but if the adjoining side of your work comply not all the way with the adjoining side of the *Square*, you must file away your work where the square rides upon it till the whole side be wrought to comply with the adjoining side of the *Square*, that is, till both the sides of your work agree with both the sides of the *Squares* when they are applyed to one another. Having tryed two sides square, make a third side of your work square by applying one of the sides of the *Square* to one



one of those sides of your work, that are already made square; and (as before) try the third untryed side, and make that square: and by the same rule make the fourth side square.

If the work you are to file be an hollow square, you must apply the outer square A B C to it, and try how, when one side of the *Square* is applyed to one side of your work, the other side of your work agrees with the other side of the *Square*; which if it do all is well: but if the *Square* and the work comply not with one another, you must file your work, where it bears the *Square* off. But to return where I left off.

Having made these two ends square, you must fit the length of them to the thickness of the *Fore* and *Backsides* into which they are to enter, but so as the squares be not full so long as to come quite through the *Fore* and *Backsides*, lest when the *Nuts* are screwed on the *Screw pins* that are at the ends of these squares they Screw full up to the squares and bear against the corners of them, which if they do, the *Nuts* will not draw the *Fore* and *Backsides* close against the shoulders of the squares, on the *Top* and *Bottom peeces*, and then the whole *Jack frame* will not stand fast and firm together.

But before you fit this *Frame* thus together you must consider the Diameter of the *Main Wheel*, that you may punch round holes in the *Fore* and *Backsides* to enter the *Main spindle*: Therefore open your Compass to half the intended Diameter of the *Main Wheel*, and half a quarter or an whole quarter of an inch more for play, between the Semi-diameter of the *Main Wheel*, and the upper flat of the *Bottom pece*, and set that distance off from the upper flat of the *Bottom peeces*, on the *Fore* and *Backsides*, and with a round punch, somewhat smaller than the intended size of the *Main Spindle*, punch holes at that setting off. Your punch must be smaller than the *Main Spindle*, because the holes may perhaps not be so exactly round, or punched so truly upright or perfectly

perfectly smooth as they ought to be, and should you make the hole so wide at first as they need to be, you could not mend them without making them wider. These holes must be punched at the *Fire or Forge* (as Smith's say, when they take an *Heat* of their work to punch it) because the *Fore* and *Backsides* are too strong (as Smiths say) that is too thick to punch with the *Cold punch*. The way of punching them you were taught *Numb. I. fol. 11, 12*. Besides a *Cold punch* is commonly made flat at the bottom, and therefore does not prick an hole, but cut an hole (if the Iron be not too strong) for that flat bottom and the round upright side about it meet in an angle or edge at the bottom, which edge by the force of an Hammer cuts the Iron (if it be not too strong) when it is laid upon a *Bolster*, as it is described, *Numb. I. fol. 12*. and should you cut out so much Iron in the *Fore* and *Backsides* as would entertain the *Main Spindle* (it being thick) you would make the *Fore* and *Backsides* too much: therefore (as I said) the holes must be prickt in the *Fore* and *Backsides* at the *Fire or Forge*, which with a sharp pointed *punch* is sooner done: nor does pricking diminish the substance or strength of the Iron, but makes it swell out at the sides, and retain both substance and strength. The irregularity or swellings out that this punching makes on the flats of the *Fore* and *Backsides*, you must Hammer down again with almost a *Blood-red heat*: I say almost a *Blood-red heat*, because should you take too great an *Heat* you may make the *Fore* and *Backsides* stretch, and so put the whole *Jack frame* out of order.

Having puncht the holes for the *Main Spindle*, you must punch the holes in the *Fore* and *Backsides* for the *Worm Wheel Spindle*, as you puncht the holes for the *Main Spindle*: But these must be small holes, to entertain the small ends or *Pins* of the *Worm wheel Spindle*.

These holes thus puncht may perhaps not be exactly round, or fit to your size, nor will they be smooth enough within:
Therefore

Therefore with a ^aSquare bore you must open them wider to your size, and that opening them in the inside will both round and smoothen them.

You must also punch a square hole towards the top of the Fore side for the Shank of the Worm Loop.

Then forge and fit in your Main wheel Spindle, and your Worm wheel Spindle, which Spindles must both be exactly straight between the centers of their two ends (unless you like to have moldings for Ornaments on them) and forge a square towards the ends of both the Spindles to fit into a square hole in the middle of the Cross of their wheels, and leave substance enough for a shoulder beyond the square to stop the square hole in the Cross of the wheels from sliding further on the Spindle, and you must leave substance of Iron enough to forge the Nut of the Worm wheel near the other end. But in this and indeed in all other forging, remember, (as I told you Numb. I. fol. 9.) that it behoves you to hammer or forge your work as true as you can, least it cost you great pains at the Vice.

Then forge the Worm Spindle, which is all the way round and straight, unless you will have moldings for Ornaments (as aforesaid) upon the Shank of it: But you must be sure to forge substance enough for the Worm to be cut out of it.

The Main and Worm wheels are forged round and flat.

The manner of Forging these Wheels (which in Smiths language is *Turning up the Wheels*, is first, to draw out a square Rod (as you were taught, Numb. I. fol. 9. among the several Heats of Iron) somewhat thicker than you intend your Wheel shall be, but it must be almost as thin on one side as you intend the inner edge of the Wheel shall be, and the opposite to it above twice that thickness, for the outer edge of the Wheel (the reason you will find by and by.) Having drawn forth your square Rod to a convenient length viz. almost threethimes the Diameter of your intended Wheel you must take almost a Flame Heat, and Hammer all along the whole length upon the thick edge, so will

H

you

you find the long Rod by this Hammering turn by degrees rounder and rounder in upon the thin edge, which you Hammer'd not upon, till it become a Circle or pretty near a Circle. But you must make it somewhat more than a Circle, for the ends must lap over one another, that they may be *welded* upon one another.

Thus may you see the reason for making the outer edge of the Rod thick, and the opposite edge thin: for your Hammering upon the outer edge onely, and not on the inner makes the outer edge a great deal thinner, and at the same time makes the *Wheel* broader.

The reason why I told you, you should draw forth the Rod to almost three times the Diameter of the Wheel, and not to the Geometrical proportion is, because that in Hammering upon it to make it round, the Rod will stretch so considerably that it will be long enough to make a *Wheel* of your intended Diameter, and most commonly somewhat to spare. But to return.

Before you take a *welding Heat* as by *Numb.I. fol.9.10.* you must flatten the two ends that are to be *welded* together to a little more than half their thickness, that when they are lapt over one another, and *welded* together they may be no thicker than the other part of the *Wheel*.

If the *Wheels* be not *Turned up* so round that with little labour you may mend them at the Vice, you must with *Blood-red Heats* Hammer them round upon the *Pike* or *Bickern* of the *Anvil*, holding with your *Tongs* the inner edge of the *Wheel* upon it, and Hammering upon the outer edge of the *Wheel*, till the *wheel* be fit for the *Vice*: Their insides must be divided into four equal parts, or four *Dufftail* notches to be filed into them. The *Dufftail* notches are cut in the inner edge of the *wheel* towards the outer edge of the *wheel*, somewhat more than a quarter of an inch deep, and spreading somewhat wider towards the outer edge. These notches are to receive the four ends of a *Cross* forged somewhat

what thicker towards the ends than the thickness of the *wheel*, and must be filed outer *Duff-tails* to let exactly into the inner *Duff-tail* notches made in the inside the *wheel*. They must be forged thicker than the *wheels*, because they must batter over both the flat sides of the *wheel*, to keep the *wheel* strong and steady upon the *Cross*; and sometimes (for more security) they are *brazed* into the *wheel* (yet that is but seldome:) the middle of this *Cross* is made broad, that when the square hole is made in the middle of it to receive the square of the *Spindle*, it may have strength enough to bear the violence offered it, as well in winding up the great weight, that keeps the *wheels* in motion, as in the checking and turning the *Jack-winder* back, to set the *Jack* a going, when by the winding up it may be subject to stand still, or sometimes for want of weight, or else for want of oyling; or some other accident.

These *wheels* thus forged and filed flat must be divided, the *Main wheel* commonly into 64 equal parts, and the *VVorm-wheel* into about thirty two equal parts: but these numbers are not exactly observ'd by Smiths, for sometimes they make them more and sometimes less, either according to the size of their *wheels*, or according as they intend their *wheels* shall go swifter or slower about (for the fewer the *Teeth* on a *wheel* are, the sooner the *wheel* goes about, and the more *Teeth* on a *wheel*, the slower the *wheel* goes about) or sometimes as they have opened their compasses to divide them: For if by luck they at first open their Compasses to such a width as will just measure out on a Circle (which they describe on the centre of the *wheel* for that purpose) their intended number, then the *wheel* shall have the intended number of *Teeth*; if not, let it somewhat fall short or exceed that number they matter not, but make that number of *Teeth* on the *wheel*. And having thus divided the *wheel*, they by the side of a straight Ruler laid to the centre, and every division mark on the *wheel*, draw or scratch a straight line from the outer limb of the *wheel* to the circle, which circle I should have

told you before) is described at that distance from the outer Verge they intend the *Teeth* shall be cut down to. This is indeed a rough way of working, but the office of a *Jack* is well enough performed by this rough work; and the usual prizes such as will scarce pay workmen for better; as they say.

These *wheels* thus divided must be cut down into these divisions with a *Jack-file*, the *Main-wheel* straight athwart the outer Verge, (which to speak Mathematically makes an angle of 90 degrees with the flat sides of the *wheel*;) and the *Worm-wheel* aslope, making an angle of about 115 degrees with its sides, that is, an angle of 25 degrees with a line drawn straight athwart the outer edge of the *wheel*; that the *Teeth* of the *Worm-wheel* may gather themselves into the *Grooves* of the *Worm* in the *Worm-spindle*; the *Worm* on the *Worm-spindle* running about 65 degrees aslope from the Axis or perpendicular of the *Worm-spindle*. The notches you make with the *File* must be so wide, as to contain about twice the thickness of each *Tooth*: Therefore you may observe that the number of *Teeth* cannot be assign'd, because the sizes of all *Jack-wheels* are not of equal Diameters, and the sizes of the *Teeth* must be filed very square and smooth, and the corners taken off, and rounded on both sides towards the middle of the top or end of the *Tooth*, which much helps the *Teeth* to gather in upon the *Teeth* of the *Nut*, and the *Worm* on the *Worm-spindle*.

The *Teeth* of the *Wheels* being cut down, and the whole *wheel* finished, they must be forced stiff and hard upon the Square of the *Spindle*, close up to the Shoulder; which Square being made somewhat longer than the *Cross* of the *wheel* is thick, must with a *Cold-Chisel* be cut on the top of that Square, to make the Iron that comes through the Square hole of the *wheel* spread over the *Cross* of the *wheel*, and then that spreading must be battered with the *Pen* of the Hammer, that it may stand up stiff against the shoulder of the Square on the other side of the *wheel*; But in doing this, you must be very careful that the *Spindle* stand exactly perpendicular to the flat sides

sides of your *Wheels*; for should the *Spindle* lean never so little to one or the other side of the *wheel*, the *wheel* when it is moving in the *Jack frame* would not move perpendicularly, but wobble towards the *Fore* or *Backsides* of the *Jack frame*, and perhaps by this irregular motion, before a revolution of the *wheel* be performed, it would go off from the length of the *Teeth* of the *Nut*.

Then file the *Spindle pins* (which are the ends of the *Spindle*, that go into the center holes of the *Fore* and *Backsides* of the *Jack frame*) exactly round and fit to their center holes, and place them in their proper center holes. Then try if the *wheels* are exactly round on their outer edges, and that in turning about their flat sides wobble not, but in a revolution keep parallel to the *Fore* and *Backsides*. The way Smiths use to try them by, is to turn them about by the *Spindle*, and holding a peece of Chalk steady to the outer limb of the *wheel*, not letting the point of the Chalk slip forwards or backwards, or towards the right or left hand, for then if the Chalk make a white stroak round the whole *wheel*, and that white stroak ly exactly parallel to the two outer edges of the *wheel*, the *wheel* is not only round, but stands also true upon its *Spindle*, (that is) perpendicular to the *Spindle*, and the *Spindle* perpendicular to the flat of it: But if the Chalk does not touch round the whole *wheel*, you must file down so much of the the outer verge of the *wheel*: where the Chalk does touch as will bring down or equalize the Diameter of the *wheel* in that place to the Diameter of the *wheel* in the place where it does not touch; so may you conclude the *wheel* is round. If the mark of the Chalk lie not exactly in the middle between the two edges of the *wheel*, then it is not perpendicular to the *Spindle*, and you must with the Hammer set it right, that is, perpendicular, by forcing the *wheel* over from the side it leans too much to, or else by forcing the *Spindle*: which is all one; yet this is an help you ought not to rely upon, to use, but in case of necessity, but rather be sure your *wheel* and *Spindle* stand perpendicular to one another before you fasten

the *Wheel* upon the square of the *Spindle*, for by this help the square on the *Spindle* will be apt to loosen in the square of the the *Wheel*, and you will have your *Wheel* to new fasten upon the square of the *Spindle* again.

As you tryed the *Wheels* with *Chalk*, so you must try the *Nut*, the *Worm*, and the *Spindles*.

The upper part of the *worm spindle* must be filed truly round to fit into the *Worm Loop*, that it shake not in it, and yet go very easily about, without the least stopping. At the very upper end of this round on the *Worm Spindle*, you must file a square to fit the square hole of the *Fly* upon.

The *Shank* of the *Worm Loop*, and the *Stud* of the *Worm Spindle* must stand so far off the left side of the *Fore side*, that the *Teeth* of the *Worm wheel* may fall full into the *Grooves* of the *worm*; for so, both being cut with the same slope, the slope *Teeth* of the *Worm wheel* will gather into the slope *Grooves* of the *Spindle*, and pressing upon the *Worm* drive about the *Worm Spindle* and the *Fly*.

The *Fly* is made sometimes with two, sometimes with four *Arms* from the center, and sometimes the *Arms* are made longer, sometimes shorter: The more *Arms* and also the longer *Arms*, are to make the *Jack* go slower.

There is yet a small matter more of Iron work about the *Jack*, which is the *Tumbler*; but it lies in the further end of the *Barrel*, and cannot well be described without a particular figure, which therefore I have inserted. As in Fig 2. A the *Barrel*, B the *Main Spindle* coming through a *Barrel*, a the center of the *Tumbler* moving upon the *Center pin*, which is fastened into an Iron plate behind the *Barrel*. b The *Collar* upon the *Main Spindle*, from which proceeds a *Tongue*, which passes through a pretty wide hole at c in the *Tumbler*, as far as e d the *Catch* of the *Tumbler*. The *Tumbler* moves (as aforesaid) upon the center hole a, but receives the *Tongue* through it at c, and passes as far as e. This *Tongue* serves as a *Check* to the *Tumbler*, that it cannot tumble above an Angle.

Angle of 30 degrees from the Iron plate it is fastened to; and that the width of its center hole, and the width of the hole the *Tongue* passes through, and the motion of the *Coller* about the *Main Spindle* allows it; but were the center hole *a*, and its *Center pin* fit, and the hole *c* and the *Tongue* that passes through it also fit, and the *Coller* fixt, it could not move at all. But this play is enough for it to do the purpose it is designed for. The *Tumbler* is so placed behind the *Barrel*, that while the *Jack line* is winding up upon the *Barrel* its round britch passes forwards by all the *Crosses* of the *Main wheel*, and the point or *Catch d*, as then claps it self snug or close to the Iron plate of the *Barrel*: But when the *Barrel* is turned the contrary way, the weight of the *Catch* in half a revolution of the *Barrel* (let the *Tumbler* be posited where it will) makes it open and fall from the Iron plate, and butt against one or other of the *Crosses* on the *Main Wheel*, and so thrusts the *Main Wheel* about with the *Barrel*.

The *Eye* of the *Winch* or *Winder* is forged as you were taught to forge the *Pin Hole* in the *Cross garnet*, Numb. II. fol. 18. But that was to be a small round hole, and therefore you were directed to lay a small round peece of Iron or Wyre where you intended the *Pin Hole* should be, and lap the other end of your work over it; But this is to be a wide square hole, therefore you must lay a square peece of Iron of your size, where the *Eye* of the *Jack Winch* shall be, and lap or double the other end over it, and *Weld* and *Work* as you were there directed. The rest of the *Winch* is but common *Forging* and *Filing* work, which hath been sufficiently taught already.

The Wood work belonging to a *Jack*, is a *Barrel*, a *Spic-wheel*, and the *Handle of the Winch*; which being *Turners* work I shall say nothing to, till I come to the Art of *Turning*. Only those *wheels* that have more than one *Groove* in them are called *Two*, *Three*, &c. *Struck-wheels* in Workmens corrupting language; But, I suppose, originally two *Strook*, three *Stroak-wheels*.

wheels, &c. from the number of *Grooves* that are in them.

The Excellencies of a good *Jack* are (1.) That the *Jack-frame* be forged and filed square, and conveniently strong, well set together, and will screw close and tight up. (2.) That the *wheels* be perpendicularly and strongly fixed on the squares of the *Spindles*. (3.) That the *Teeth* be evenly cut, and well smoothed, and that the *Teeth* of the *Worm-wheel* fall evenly into the *Groove* of the *Worm*. (4.) That the *Spindle-pins* shake not between the *Fore* and *Bark sides*, nor are too big or too little for their center-holes.

^a The *Square-bore* is a square Steel point or shank, well temper'd, fitted into a square Socket in an Iron *wimble*: It is described, fig. 3. its use is to open a hole, and make it truly round, and smooth within, when you use it you must set the head against your Breast, and put the point of the *Square-bore* into the hole you punched or would open, and turning the Handle about you with it turn about the shank of the *Square-bore*, whose edges cut away the irregularities of the Iron made in the punching. But you must thrust or lean hard with your Breast against the Head of the *Square-bore*, that it may cut the faster: And you must be sure to guide the *Square-bore* truly straight forwards in the hole, lest the hole be wrought aslope in the Iron.

^b To open an hole, is in Smiths language to make the hole wider.

^c A *Duff-tail* is a figure made in the form of a Doves tail, and is used by many other Handicrafts as well as by Smiths, but most especially by Joyners, as I shall shew, when I come to *Jynery*.

^d A *Jack-file* is a broad File somewhat thin on both edges, and stronger in the middle.

The manner of making *Molds* to cast *Leaden Bullets* in.

I insert the making of *Bullet Molds*, because there is some sort of Work in them different from what hath yet been taught. The Handles and the Head are forged as other Work, but the

two concave Hemispheres are first punched with a round ended *Punch*, of the shape and almost the full size you intend the *Bullet* shall be. They must be punched deep enough at the *Forge* with a *Blow-red Heat*: Then are the edges of the chaps filed flat, first with a *Common file* the common way, but afterwards with an *Using File*, as Workmen call it: The *Using File* is a long and broad file exactly flat on both its cut sides, having a square Iron handle drawn out at one end with an hole in it; but the handle is not to hold it by, when you use it, but the hole in it to go over a pin you hang it upon, when you do not use it. When you use it, you must lay it flat upon the *Work bench*, with its handle from you, and you must take care that it lie solid and steddly, lest when you work upon it, it slip from you; therefore you may strike a nail in at the hole of the *Handle*, a little way into the *Work bench*, that you may draw it again, when you have done with the *Using File*, and you may drive in a small *Tack* on each side the *Using File*, to keep it steddly, or you may tack down two small thin boards on either side the *Using File*, to keep it steddly, and rip them off again when you have done. Your *Using File* lying thus straight and steddly before you, lay the chaps of one half of the *Mold* flat upon the hither end of the *Using File* and holding your two thumbs, and your two fore-fingers upon the Head of the *Mold*, thrust your work hard down from you the whole length of the *Using File*, then draw your work lightly back, and thrust it again hard from you; reiterate these thrusts, thus till upon the chaps of the *Mold*, you can see no irregularities, or the File strokes of the common File left, so may you be sure that the chaps of the *Mold* is truly flat. Do the like by the other half of the *Mold*.

Now you must try whether each of these Concaves be an exact half round; thus, you may describe an Arch a little more than a Semi-Circle, just of the Diameter of your *Bullet* upon the end of a thin peece of *Brass latten*, draw a straight line thorough

through the Center and the Arch on both sides it, for the limits of a Semi-Circle: File very curiously all the Brass away on the end just to this Semi-Circle, and just to the Diametral line on either side the Semi-Circle; so have you a convex Semi-Circle: Put this convex Semi-Circle into the concave *Molds*, if it fits them so as the convex reaches just the bottom of the *Molds*, when its shoulder touches just the chaps of the *Mold*, they are each a true concave Hemisphere. But if the shoulder of the convex (that is the Diametral line prolong'd) rides upon the chaps of the concave, and the bottom of the convex touch not the bottom of the concave, the concave is punched too deep, and must have its chaps rubb'd upon the *Using File* again, till it comply with the convex. Then put into the two concaves a round *Bullet*, that will just fill them both, and pinching the Heads of the *Mold* close together in the *Vice*, with the *Bullet* in it, drill an hole through both the Handles for the *Joyn*. The reason why the *Bullet* is put into the *Mold*, is because the chaps of the two halves should lie exactly upon one another, while the hole for the *Joyn* is drilling. Then fix a rivet pin for this hole, and rivet them together, but not so hard but that they may open and shut pretty easie, and yet go true. Then take the *Bullet* out, and file in each half of the Head half a round hole directly against one another for the *Grat*, which two half holes, when the *Mold* is shut, will make one round hole.

You may now try with Clay, or by casting a leaden *Bullet* in it, whether it be exactly round or No; for making a true round hole in a thin peece of Brass, just of the circumference of the chaps, you may try if the cast *Bullet* will just pass through, and also fill that hole when the *Bullet* is turned every way: which if it do, you may conclude the *Mold* is true. This thin peece of Brass, with a round hole in it, is called a *Sixer*.

But the inside wants cleansing, for hitherto it is only punched. Therefore you must provide a *Bullet Bore*, with which you may bore the inside of each half to clear it. Or if they be

be not quite deep enough puncht you may bore them deeper. You may bore them severally, or together, by putting the *Bullet bore* into the *Mold* so, as the *Shank* may come through the *Geat*.

In this Section you see, first the use of a *using File*, an Instrument of great use for flat Filing; for by it you may make two peeces of Iron of somewhat considerable breadth, so true that by laying the two flat sides upon each other, they shall draw up one another. It is much used by *Clock-makers*, *Watch-makers*, *Letter-Mold-makers*, and indeed all others that frame square work on Iron, Steel or Brass. Secondly, the use of a *Bullet bore*, which, though it be seldome used, yet it may serve you, not only for *Bullet Molds*, but for other purposes: and by altering it's shape into an Oblong, a Cone, or a Cylinder, you may Bore these hollow Figures either for *Molds*, or some other accidental uses.

• A *Geat* is the hole through which the *Mental* runs in to the *Mold*. The word is used by most *Founders*.

• The *Bullet-bore* is a *Shank* of steel, having a steel Globe or *Bullet* at one end, just of your intended *Bullets* size. This Globular end must be harcht with a fine-cut, by a *File-Cutter*, and hardned and tempered. The end of the *Shank* this Globular *Bore* is fastned to, must be round and so small when the *Bullet bore* is in the *Mold* the *Geat* will easily recieve it. The other end of the *Shank* must be fitted into the square Socket of the *Wimble*, and have a shoulder to it, to stop the Socket from sliding too far upon the *Shank*: From this shoulder the rest of the *Shank* must run tapering down to the small end the *Bullet bore* is fastned to. You must work with it as you were taught to work with the *Square bore*.

Of *Twisting of the Iron*.

Square and flat Bars sometimes are by Smiths *Twisted* for Ornament: It is very easily done; for after the Bar is square or flat forged (and if the curiosity of your work require it truly Filed) you must take a *flame Heat*, or if your work be small but a *Blood-red Heat*, and you may *twist* it about, as much or

as little as you please, either with the *Tongs, Vice, or Hand-vice, &c.*

Of Case Hardning.

Case Hardning is sometimes used by *File-cutters*, when they make course Files for cheapness, and generally most *Rasps* have formerly been made of Iron and *Case-hardned*, because it makes the outside of them hard. It is used also by *Gun Smiths* for hardning their Barrels: And it is used for *Tobacco Boxes, Cod-peece Buttons, Heads for walking staves, &c.* and in these Cases workmen, to set a greater value on them in the Buyers esteem, call them *steel Barrels, steel Tobacco Boxes, steel Buttons, steel Heads, &c.* But Iron thus hardned takes a better Pollish, and keeps the Pollish much longer and better, than if the Iron were not *Case-hardned*. The manner of *Case-hardning* is thus. Take *Cow-horn* or *Hoof*, dry it through'y in an Oven, and then beat it to Powder, put about the same quantity of Bay Salt to it, and mingle them together with stale Chamberley, or else with white Wine Vinegar. Lay some of this mixture upon Loam, made as you were taught, *Numb. I. fol. 13.* and cover your Iron all over with it; then wrap the Loam about all, and lay it upon the Hearth of the Forge to dry and harden: when it is dry and hard, put it into the Fire, and blow up the Coals to it, till the whole lump have just a Blood red heat, but no higher than a blood-red heat, least the quality of your mixture burn away, and leave the Iron as soft as at first. Then take it out and quench it. Or instead of Loam you may wrap it up in plate Iron, so as the mixture may touch every part of your Work, and blow the Coals to it, as aforesaid.

Of several sorts of steel in common use among Smiths.

The difficulty of getting good steel makes many Workmen (when by good hap they light on it) commend that Countrey steel for best from whence that steel came. Thus I have found some cry up *Flemish steel*, others *Swedish steel*, others *English, Spanish, Venice, &c.* But according to my observation

and the common consent of the most ingenious Workmen, each Country produces almost indifferently good and bad: yet each Country doth not equally produce such Steel as is fit for every particular purpose, as I shall shew you by and by. But the several sorts of Steel, that are in general use here in *England*, are the *English Steel*, the *Flemish*, the *Swedish*, the *Spanish*, and the *Venice Steel*.

The *English Steel* is made in several places in *England*, as in *Yorkshire*, *Gloucestershire*, *Sussex*, the *Wilde of Kent*, &c. But the best is made about the *Forrest of Dean*; it breaks fire with somewhat a coarse grain: But if it be well wrought and proves sound it makes good Edge Tools, Files, and Punches. It will work well at the forge, and take a good heat.

The *Flemish Steel* is made in *Germany* in the Country of *Stiermark*, and in the *Land of Layck*: From thence brought to *Colen*, and is therefore sometimes called *Colen steel*: From *Colen* it is brought down the *River Rhine* to *Dort* and other parts of *Holland* and *Flanders*, some in Bars and some in *Gads*, and is therefore by us called *Flemish Steel*, and sometimes *Gad Steel*. It is a tough sort of Steel, and the onely Steel used for Watch-Springs. It is also good for Punches, File-Cutters also use it to make their Chisels of, with which they cut their Files. It breaks with a fine grain, works well at the Forge, and will take a welding heat.

I cannot learn that any Steel comes from *Sweden*, but from *Dantzick* comes some which is called *Swedish Steel*, it is much of the same quality and fineness with *Flemish Steel*.

The *Spanish Steel* is made about *Biscany*. It is a fine sort of Steel, but some of it very difficult to work at the Forge, because it will not take a good heat; and it sometimes proves very unsound, as not being well *curried*, that is well wrought. It is too quick (as Workmen call it) that is, too brittle for Springs or Punches, but makes good Edge Tools.

Venice Steel is much like *Spanish Steel*, but more fine, and works somewhat better at the Forge. It is used for Razors,

Chirurgeons Instrumens, Gravers, &c. because it will come to a fine and thin edge. Razor-makers generally clap a small Bar of *Venice Steel* between two small Bars of *Flemish Steel*, and so work or weld them together, to strengthen the back of the Razor, and keep it from cracking.

There is another sort of Steel of higher commendations than any of the foregoing sorts. It is called *Damascus Steel*: It is very rare that any comes into *England* unwrought, but the *Turkish Symeters* are generally made of it. It is the most difficult of any Steel to work at the Forge, for you shall scarce be able to strike upon a blood heat, but it will *Red Sear*; in so much that these Symeters are by many Workmen thought to be cast Steel. But when it is wrought it takes the finest and keeps the Strongest edge of any other Steel. Workmen set almost an inestimable value upon it, to make Punches, Cold-Punches, &c. of. We cannot learn where it is made, and yet as I am inform'd, the Honourable Mr. *Boyl* hath been very careful and industrious in that inquiry; giving it in particular charge to some Travellers to *Damascus* to bring home an account of it: But when they came thither they heard of none made there, but were sent about fifty miles further into the Country, and then they were told of about fifty miles further than that: so that no certain account could be gained where it is made.

The Rule to know good Steel by.

Break a little piece of the end of the Rod, and observe how it breaks: for good Steel breaks short off, all gray like frost work silver. But in the breaking of the Bad you will find some veins of Iron shining and doubling in the Steel.

Of Nealing of Steel.

Having chose your Steel and forged it to your intended shape, if you are either to file upon it, or to engrave upon it, or to punch upon it, you ought to Neal it first, because it will make it softer, and consequently work easier. The common way is to give it a blood red heat in the fire, then take it out, and let it cool of it self.

There

There are some Pretenders to know how to make Steel as soft as Lead : But so oft as my curiosity has prompted me to try their pretended processes, so oft have they failed me ; and not onely me, but some others, Careful Observers. But the Way they most boast of, is the often heating the Iron or Steel in red hot Lead, and letting it cool of it self, with the Lead: I have many times tried this without any other success than that it does indeed make Iron or Steel as soft, as if it were well Neald the common way, but no softer : And could it be otherwise, the small Iron Ladles, that Letter-Founders use to the casting of Printing Letters, would be very soft indeed, for these iron Ladles are kept constantly month after month in melted Metall, whereof the main Body is Lead, and when they cast small Letters they keep their Metall red hot ; and I have known them many times left in the Metall, and cool with it as the fire has gone out of it self ; but yet the Iron Ladles have been no softer than if they had been well Neald the common way. But perhaps these pretenders mean the Iron or Steel shall be as soft as Lead, when the Iron or Steel is red hot.

But that which makes Steel a very small matter softer than the common way of Nealing is, by covering the Steel with a course Powder of Cow-horns or Hooves, or Rams-horns, and so inclosing it in Loam ; then put the whole lump into a wooden Fire to heat red hot, and let it lie in the Fire till the Fire go out of it self, and the steel cool with the Fire.

Of hardning and Tempering steel.

English, Flemish, and Swedish Steel must have a pretty high heat given them, and then suddenly quenched in water to make them very hard ; but *Spanish and Venice Steel*, will need but a Blood-red heat, and then when they are quenched in Water will be very hard. If your Steel be too hard, that is too brittle, and it be an edged or pointed Instrument you make, the edge or point will be very subject to break : Or if it be a Spring it will not bow, but with the least bending it will snap asunder : Therefore you must let it down, (as Smiths say) that is, make it softer,

by

by *Tempering* is. The manner is thus, take a peece of Grin-stone, or Viner-stone, and rub hard upon your work to take the black scurf off it, and brighten it: then let it heat in the Fire; and as it grows hotter you will see the colour change by degrees, coming first to a light Goldish colour, then to a darker Goldish colour, and at last to a Blew colour: select which of these colours your work requires, and then quench it suddenly in water. The light Goldish colour is for Files, Cold Chissels, and Punches that punch into Iron or Steel: The dark Goldish colour for punches to use on Brass, and generally for most edge Tools: The blew colour gives the Temper to Springs in general, and is also used to beautifie both Iron and Steel: but then Workmen sometimes grind *Indico* and salled Oyl together, and rub that mixture upon it, with a woollen rag while it is heating, and let it cool off it self.

There is another sort of hardning, called *Hammer hardning*. It is most used on Iron or Steel Plates, for Dripping-pans, Saws, straight Rulers, &c. It is perform'd onely, with well Hammering of the Plates, which both smooths them, and beats the Mettal firmer into its own Body, and so somewhat hardens it.

The manner of Forging steel, either for edge Tools, Punches, Springs, &c. Is (the several shapes considered) the same with Forging Iron: Onely this General Rule observe from an Old English Verse used among Smiths, when they Forge edge Tools,

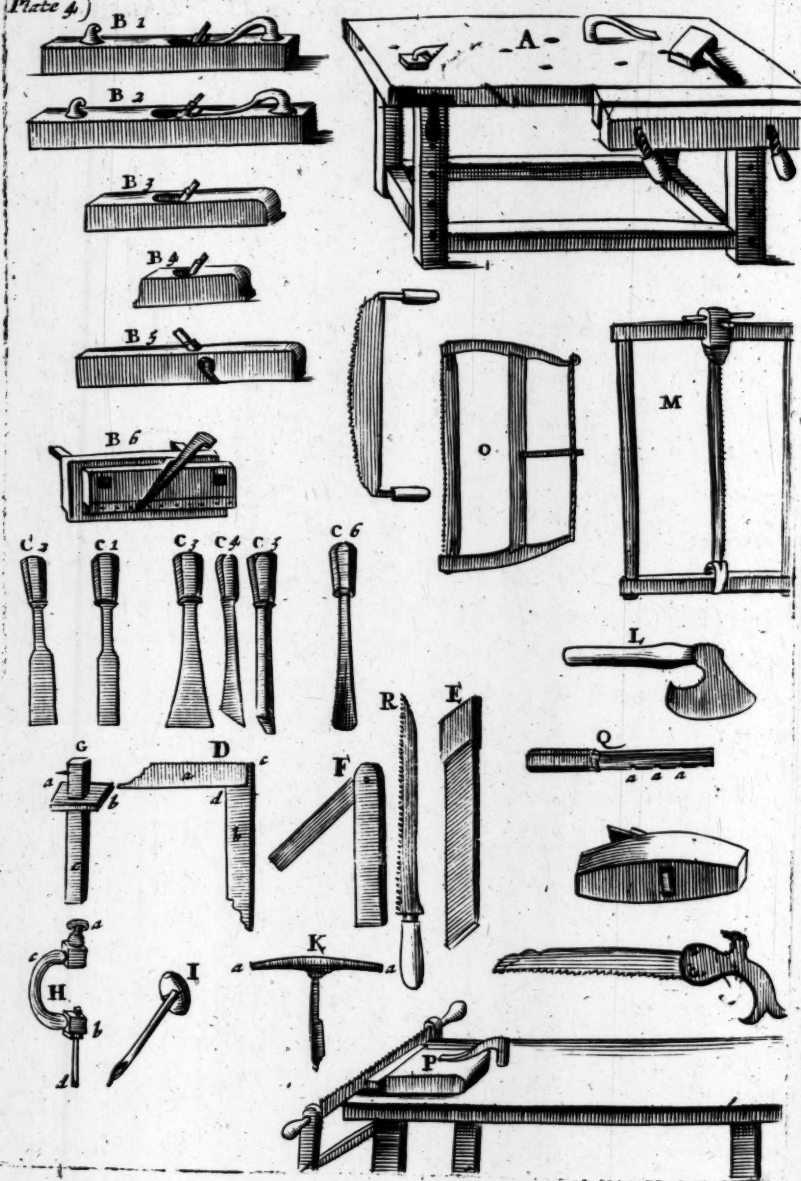
*He that will a good Edge win,
Must Forge thick and Grind thin.*

Thus much of Smithing. Only, in the foregoing Exercises some mistakes have been committed. *Viz.* Numb. I, fol. 2, l. 22. read, and hath one of its boards fixed: l. 20. for upper Board r. moving Board. l. 32. for upon it sinks r. the top of its upper Board sinks. In Numb. II. in fig. 2. of the Plate, in the Arch about B, two small strokes through the Arch are omitted, which should be marked E E, as in fig. 3. the Strokes D D are marked; and the letter D is omitted, which should stand in fig. 2. where C in fig. 3. stands. fol. 28 l. 10. for N N r. L L. The Wind-up-peece is twice mis-markt, viz. in Numb. III, fol. 37. l. 14. D for E, and l. 17. L for E the end of the Main-Spindle that comes through the fore-side Jack-frame, whereon the Jack-winder is fitted, is called the wind-up-piece.

Mechanik Exercises

No. 4 - 5 - 6

(Plate 4)



MECHANICK EXERCISES,

O R,

The Doctrine of
Handy-works.

*From April the 1. to May the 1.
1678. And is intended to be
Monthly continued.*

By *Joseph Moxon* Hydrographer to
the King's most Excellent Majesty.



L O N D O N,
Printed for *Joseph Moxon*, at the Sign of *Atlas* on
Ludgate Hill. 1678.

MECHANICAL

WHEELS

or

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MECHANICK EXERCISES.

OR,

The Doctrine of *Handy-works*.The Art of *Foynery*.*Definition.*

Joynery is an Art Manual whereby several Pieces of Wood are so fitted and joyned together by straight Lines, Squares, Miters, or any Bevel, that they shall seem one intire Piece.

Explanation.

By *straight Lines* I mean that which in Joiners Language is called a *Foynt*, That is, Two Pieces of Wood are *Shot* (that is Plained,) or else they are *Pared*, that is, the irregularities that hinder the closing of the two Pieces are cut off with a *Paring Chisel*. They are *Shot* or *Pared* (as I said) so exactly straight, that when they are set upon one another light shall not be discerned betwixt them. This they call *Shooting of a Foynt*, or *Paring to a Foynt*, because these two Pieces are with Glew commonly joyned together, either to make a Board broad enough for their purpose, or to (^a) *Clamp* one piece of wood to the end of another piece of wood to keep it from *casting* or *warping*.

By *Squares* I mean the making of *Frames*, either for *Door-cases*, or such like, which is the Framing

L

of

of two pieces of wood athwart two other pieces of wood, so as the four Angles of the *Frame* may comply with the *Square*, marked D.

By *Miters* are meant the joyning of two pieces of wood, so as the Joynt makes half a Square, and does comply with the *Miter Square*, marked E.

By a *Bevil* is meant any other Angle: As *Frames* that may be made of *Pentagon*, *Hexagon*, *Octagon*, &c. Figures.

§ I. The Names of *Joyners Tools* described.
In Plate III.

A *A Work-Bench*. b The *Hook* in it, to lay Boards or other ^b *Stuff* flat against, whiles they are ^c *Trying* or *Plaining*. c The *Bench-Screw* (on its hither side) to *Screw* Boards in whiles the edges of them are *Plaining* or ^d *Shooting*; and then the other edge of the Board is set upon a *Pin* or *Pins* (if the Board be so long as to reach to the other *Leg*) put into the *Holes* marked a a a a a down the *Legs* of the *Bench*; which *Pin* or *Pins* may be removed into higher or lower *Holes*, as the breadth of the Board shall require: So then, the *Bench-Screw* keeps the Board close to the edge of the *Bench*, and the *Pins* in the *Legs* keep it to its height, that it may stand steddily whiles the other edge is working upon: For in the *Shooting* of a *Joynt*, if the Board keeps not its exact position, but shakes or trembles under the *Plain*, your *Joynt* will very hardly be truly straight. d The *Hold fast*, let pretty loose into round holes marked b b b b b, in the *Bench*: Its office is to keep the work fast upon the *Bench* whiles you either *Saw*, *Tennant*, *Mortess*, or sometimes *Plain* upon it, &c. It performs this office with the knock of an *Ham-*

mer or *Mallet* upon the *head* of it; for the *Beak* of it being made crooked downwards, the end of the *Beak* falling upon the flat of the *Bench* keeps the *Head* of the *Hold-fast* above the flat of the *Bench*, and the hole in the *Bench* the *Shank* is let into being bored straight down and wide enough to let the *Hold-fast* play a little, the *Head* of the *Hold-fast* being knockt, the point of the *Beak* throws the *Shank* aslope in the hole in the *Bench*, and presses its backside hard against the edge of the *Hole* on the upper Superficies of the *Bench*, and its Foreside hard against the opposite side of the under Superficies of the *Bench*, and so by the point of the *Beak* the *Shank* of the *Hold-fast* is wedged between the upper edge and its opposite edge of the round hole in the *Bench*. Sometimes a *double Screw* is fixed to the side of the *Bench* as at *g*: or sometimes its farther *Cheek* is laid an edge upon the flat of the *Bench*, and fastned with an *Hold-fast*, or sometimes two on the *Bench*. e *A Mallet*.

§ 2. BBBBBBBB *Plains* of several sorts: as,

B1 *A Fore Plain*. a The *Tote*. b The *Mouth*. c The *Wedge*. d The *Iron*. e The *Sole*. f The *Fore-end*, g The *Britch*. f g h The *Stock*. All together *A Plain*. It is called the *Fore Plain* because it is used before you come to work either with the *Smooth Plain* or with the *Joynter*. The edge of its *Iron* is not ground upon the straight, as the *Smooth Plain* and the *Joynter* are, but rises with a *Convex Arch* in the middle of it; for its Office being to prepare the *Stuff* for either the *Smoothing Plain* or the *Joynter*, Workmen set the edge of it e *Ranker* than the edge either of the *Smoothing Plain* or the *Joynter*, and should the *Iron* of of the *Plain* be ground to a straight edge, and it be set

never so little *Ranker* on one end of the edge than on the other, the *Ranker* end would (bearing as then upon a point) in working dig Gutters on the Surface of the *Stuff*; but this *Iron* (being ground to a Convex Arch) though it should be set a little *Ranker* on one end of its edge than on the other, would not make Gutters on the Surface of the *Stuff*, but (at the most but) little hollow dawks on the *Stuff*, and that more or less, according as the *Plain* is ground more or less arching. Nor is it the Office of this *Plain* to smooth the *Stuff*, but only (as I said) to prepare it, that is, to take off the irregular Risings, whether on the sides or in the middle, and therefore it is set somewhat *Ranker*, that it may take the irregularities the sooner off the *Stuff*, that the *Smoothing Plain* or the *Foynter* may afterwards the easier work it *Try*. The manner of *Trying* shall be taught when I come to Treat of the use of the *Rule*.

You must note, that as I told you in *Smithing*, Numb. I. fol. 14, 15, 16. it was the office of the *course tooth'd File* to take off the prominent irregularities the *Hammer* made in the *Forging*, &c. and that you were not to file them more away than you need, so the same Caution is to be given you in the using of this *Fore Plain* in *foynery*, for the reason there alledged in *Smithing*, whither, to avoid repetition, I refer you; only with this consideration, that there *Iron* or *Steel* was the matter wrought upon, and there a *course File* the *Tool*; but now *Wood* is the matter, and a *Course* or *Fore-plain* the *Tool*.

§ 3 Of setting the Iron. d.c.

When you *set* the *Iron* of the *Fore-Plain*, consider the *Stuff* you are to work upon, *viz.* whether it be *hard* or *soft*, or *Curling*, as *Joyners* call *Cross-grained Stuff*: If it be *hard* or *curling*, you must not *set* the *Iron* very *rank*, because a mans strength will not cut deep into *hard wood*; and if it be not *hard wood*, but *curling* or *knotty*, and the *Iron* *rank set*, you may indeed work with it till you come to some *knot* or *curl*, but then you may either tear your *Stuff*, or break the edge of your *Iron*: therefore you may perceive a reason to *set* the *Iron* *fine* for *curling* and *knotty* *stuff*.

But if you ask me how *rank* your *Iron* ought to be *set*: I answer, If your wood be *soft* and your *Stuff* *free* and *frowy*, that is, evenly temper'd all the way, you may *set* the *Iron* to take a shaving off the thickness of an old coined shilling, but scarce thicker; whereas, if your *Stuff* be *hard*, or *curling*, or *knotty*, you shall scarce be able to take a shaving off the thickness of an old Groat. Therefore you must examine the temper of your *Stuff*, by easy tryals, how the *Plain* will work upon it, and *set* your *Iron* accordingly. And observe this as a General Rule, that the *Iron* of the *fore-Plain*, is for the first working with it to be *set* as *rank* as you can make good work with; and that for speed sake.

If your *Iron* be *set* too *rank*, knock with an *Hammer* upon the *Britch* of the *Stock*, and afterwards upon the *wedge*, for this knocking upon the *Britch*, if you knock hard enough 'twill raise the *Iron* a little, and *set* it *fine*; if you knock not hard enough, you must knock again, till the *Iron* do rise, but if you

knock too hard, it will raise the *Iron* so much, that its ^{ver}edge will rise above the *Sole* into the *Mouth* of the *Stock*, and consequently not touch the *Stuff*: therefore you must knock softly at first, till by try-als you find the *Iron* rises to a convenient *fineness*. But as this knocking on the *Brutch* raises the *Iron*, so it also raises and loosens the *wedge*: therefore (as afore-said) whenever you knock upon the *Brutch*, you must also knock upon the *wedge*, to fasten the *Iron* again.

If you have raised the edge of the *Iron* too *fine*, you must knock softly upon the head of the *Iron*, and then again upon the *wedge*, and this you may sometimes do several times, till you fit your *Iron* to a convenient *fineness*.

When you have occasion to take your *Iron* out of the *Stock* to *rub* it, that is to *whet* it, you may knock pretty smart blows upon the *Stock*, between the *Mouth* and the *Fore-end*, to loosen the *wedge*, and consequently the *Iron*.

These ways of *setting* are used to all other *Plains*, as well as *Fore-plains*.

In the using of this, and indeed all other *Plains*, you must begin at the hinder end of the *Stuff*, the Grain of the wood laying along the length of the *Bench*, and Plain forward till you come to the fore-end, unless the *Stuff* proves *Cross-grain'd*, in any part of its length; for then you must turn your *Stuff* to Plain it the contrary way so far as it runs *Cross-grain'd*. And in Plaining you must at once lean pretty hard upon the *Plain*, and also thrust it very hard forwards, not letting the *Plain* totter to or from you-wards, till you have made a stroak the whole length of the *Stuff*. And this sometimes if your *Stuff* be long, will require your making two or three steps

steps forwards, ere you come to the fore-end of the *Stuff*: But if it do, you must come back, and begin again at the farther end, by the side of the last Plain'd, stroak, and so continue your several lays of Plaining, till the whole upside of the *Stuff* be Plain'd.

And if the *Stuff* be broad you are to Plain upon, and it *warp* a little with the *Grain*, or be any ways crooked in the bredth, you must then turn the *Grain* athwart the *Work-Bench*, and Plain upon the *Cross-Grain*. For, if your work be hollow in the middle, you must Plain both the Bearing sides thinner, till they come to a *Try* with the middle. Then turn the other side of your work, and working still *Cross-grain'd*, work away the middle, till it come *Try* with the two sides.

This way of *Cross-Grain'd* working, is by Workmen called *Traversing*.

Thus have you in general the use of all the other *Plains*: But the use of those *Plains* that are designed for other particular purposes, I shall shew as they come in Order.

§ 4 Of the *Joynter*. B 2.

The *Joynter* is made somewhat longer than the *Fore-plain*, and hath its *Sole* perfectly straight, from end to end. Its office is to follow the *Fore-plain*, and to *shoot* an edge perfectly straight, and not only an edge, but also a Board of any thickness, especially when a *Joynt* is to be *shot*. Therefore the Hand must be carried all along the whole length with an equal bearing weight, and so exactly even and upright to the edges of the Board, that neither side of the *Plain* encline either inward or outwards,
but

but that the whole breadth be exactly square on both its sides; supposing its sides straight: so will two edges of two boards, when thus *shot*, ly so exactly flat and square upon one another, that light will not be discerned betwixt them. But yet it is counted a piece of good workmanship in a *Joyner*, to have the craft of bearing his hand so curiously even, the whole length of a long Board: and yet it is but a sleight to those Practice hath inur'd the Hand to. The *Joynter* is also used to Try Tables with, (large or small) or other such broad work; and then *Joyners* work as well upon the *Traverse* with it as with the Grain of the wood, and also Angularly or Corner-wise, that they may be the more assur'd of the flatness of their work.

Its *Iron* must be set very fine, so fine, that when you wink with one Eye and set that end the straight side of the *Iron* is next to the other Eye, there appear a little above an hairs breadth of the edge above the superficies of the sole of the *Plain*, and the length of the edge must ly perfectly straight with the flat breadth of the sole of the *Plain*: For the *Iron* being then well wedg'd up, and you working with the *Plain* thus set, have the greater assurance, that the *Iron* cannot run too deep into the *Stuff*, and consequently you have the less danger that the *Joynt* is wrought out of straight,

§ 5. The Use of the *Strike-block*.

The *Strike-Block* marked B 3. is a *Plain* shorter than the *Joynter*, having its sole made exactly flat, and straight, and is used for the shooting of a short *Joynt*; because it is more handy than the long *Joynter*. It is also used for the framing and fitting the
 Joynts

Joynts of *Miters* and *Bevels*; but then it is used in a different manner from other *Plains*: For if the *Miter* and *Bevel* you are to fit be small, you must hold it very steady in your left hand, with the *Sole* of it upwards, and its fore-end towards your right hand: and you must hold your work in your right hand very steady: Then apply the *Sawn Miter* or *Sawn Bevel* end of your *Stuff*, to the fore-end of the *Strike-Block*, and so thrust it hard and upright forwards, till it pass over the edge of the *Iron*, so shall the edge of the *Iron*, with several of these thrusts continued, cut or plain off your *stuff* the roughness that the *Teeth* of your *Saw* made: But if your work be so big that you cannot well wield it in your right hand, you must set the end of your work in the *Bench-screw*, and Plain upon it with a *Smoothing Plain*.

§ 6. *The Use of the Smoothing Plain.*

The *Smoothing Plain* marked B 4. must have its *Iron* set very *fine*, because its Office is to smoothen the work from those Irregularities, the *Fore-Plain* made.

§ 7. *The Use of the Rabbet Plain.*

The *Rabbet-Plain* marked B 5. is to cut part of the upper edge of a Board or other *Stuff* straight, that is, square down into the Board, that the edge of another Board also cut down in the same manner, may fit and joyn into the Square of the first board thus cut away: And when two Boards are thus lapped on the edges over one another, this *lapping* over is called *Rabbetting*.

The *Rabbet Plain* is also sometimes used to strike

a *Facia* in a peice of *Molding*; as shall be shewed in its proper place.

The sides of the *Iron* are not inclosed in the *Stock* of this *Plain*, as the foregoing *Plains* are, but the *Iron* is full as broad as the *Stock* is thick, that the very angles of the edge of the *Iron* may not be born off the *stuff*, to hinder the straight and square cutting it down: nor doth it deliver its shaving at a *Mouth* on the top of the *Stock* as the other *Plains* do: But it hath its *Mouth* on the sides of the *Plain*, and delivers its shavings there. Its *Iron* is commonly about an Inch broad.

§ 8. The Use of the Plow.

The *Plow* marked B 6. is a narrow *Rabbit-Plain* with some additions to it: viz. two square *Staves*, marked a a (yet some of them have the upper edges of them rounded off for the better compliance with the Hand) These *Staves* are let stiff through two square *Mortesses* in the *Stock*, marked b b. They are about seven or eight Inches long, and stand straight and square on the farther side of the *Stock*; and these two *staves* have sholders on the higher side of the *Stock* reaching down to the wooden sole of the *Plain* (for there is also an *Iron sole* belonging to the *Plow*) To the bottom of these two Sholders is Rivetted with Iron Rivets a *Fence* (as workmen call it) which comes close under the *Wooden sole*, and its depth reaches below the *Iron sole* about half an Inch: Because the *Iron* of the *Plow* is very narrow, and the sides of it towards the bottom are not to be inclosed in the *Stock*, for the same reason that was given in the *Rabbit-plain*; therefore upon the *Stock* is let in and strongly nailed an Iron Plate of the thickness of the *Plow Iron*, for wood of

of that bredth will not be strong enough to endure the force the lower end of the *Plow Iron* is put to : This *Iron Plate* is almost of the same thickness that the bredth of a *Plow Iron* is. Joyners have several *Plows* for several widths of *Grooves*.

The Office of the *Plow* is to *plow* a narrow square *Groove* on the edge of a Board ; which is thus perform'd. The Board is set an edge with one end in the *Bench-screw*, and its other edge upon a *Pin* or *Pins* put into a *Hole* or *Holes* in the *Leg* or *Legs* of the *Bench*, such an *Hole* or *Holes* as will most conveniently for height fit the bredth of the Board; Then the *Fence* of the *Plow* is set to that distance off the *Iron Plate* of the *Plow* that you intend the *Groove* shall ly off the edge of the Board : As if you would have the *Groove* ly half an Inch off the Board, then the two *staves* must with the *Mallet* be knocked through the *Mortesses* in the *stock* till the *Fence* stands half an Inch off the *Iron Plate* : And if the *staves* are fitted stiff enough in the *Mortess* of the *stock*, it will keep at that distance whiles you *Plow* the *Groove* : For the *Fence* (lying lower than the *Iron* of the *Plain*) when you set the *Iron* of the *Plow* upon the edge of the Board, will ly flat against the farther edge of the Board, and so keep the *Iron* of the *Plow* all the length of the Board at the same distance from the edge of the Board that the *Iron* of the *Plow* hath from the *Fence*. Therefore your *Plow* being thus fitted, *Plow* the *Groove* as you work with other *Plains*, only as you layd hold on the *stock* of other *Plains* when you use them, now you must lay hold of the two *staves* and their *sholders*, and so thrust your *Plow* forwards, till your *Groove* be made to your depth.

If the *Staves* go not stiff enough in the *Mortises* of the *stock*, you must stiffen them by knocking a little wooden wedge between the *staves* and their *Mortesses*.

§ 2. Of Molding Plains.

There are several other *Plains* in use among *Joiners*, called *Molding-plains*; as, the *Round*, the *Hollow*, the *Ogee*, the *Snipes-Bill*, the *Rabbit-plain*, the *Grooving-plain*, &c. And of these they have several sorts, *viz.* from half a quarter of an Inch, to an Inch and a half. They are used as other *Plains* are.

In the *Plaining* of *stuff*, you must use *Plains* whose *Irons* have different *Mountings*; and that according to the hardness or softness of the *Wood* you are to work upon: For if the wood be hard, the *Iron* must stand more upright than it need do if the wood be soft: For soft wood, as *Deal*, *Pear-tree*, *Maple*, &c. The *Iron* is set to make an Angle of 45 degrees with the *Sole* of the *Plain*: But if it be very hard wood you are to *Plain* upon, as *Box*, *Ebony*, *Lignum Vita*, &c. It is set to 80 degrees, and sometimes quite upright: so that these hard woods are indeed more properly said to be *Scraped*, than *Plained*.

But before you come to use your *Plains*, you must know how to grind and whet them, for they are not so fitted when they are bought, but every workman accomodates them to his purpose, as if it be an hard wood he is to work on, he grinds his *Basil* to a more obtruse Angle than he would do for soft wood.

The *Basil* or Angle an *Iron* is ground to, to work on soft wood is about 12 degrees, and for hard wood about

about 18 or 20 degrees. Where note, that the more acute or thinner the *Basil* is the better and smother the *Iron* cuts, and the more obtuse and thicker, the stronger the edge is to work upon hard work.

§. 10. *Of Grinding and Whetting the Iron, and other Edge-Tools.*

When you grind your *Iron*, place your two thumbs under the *Iron*, and your Fingers of both hands upon the *Iron*, and so clap down your *Iron* to the stone, holding it to that Angle with the *Stone* you intend the *Basil* shall have: keep the *Iron* in this posture without either mounting or sinking its ends all the while the *Stone* is turning about; And when you lift the *Iron* off the *Stone*, to see if it be ground to your mind; if it be not, you must be sure you place the *Iron* again in the same Position on the *Stone* it had before: for else you will make a double *Basil* on your *Iron*: But if it be true set on the *Stone* and steddily kept to that Position your *Basil* will be *Hollow*, and the smaller your *Grindstone* is, the hollower it will be. You may know when it is well Ground, by the evenness and entireness of the edge all the way.

Having ground your *Iron*, you must smoothen the edge finer with a good fine *Whet-stone*. Thus, hold the edge of your *Iron* upwards in your left hand and your *Whet-stone* in your right, and having first spit upon your *Stone* to wet it, apply it to the *Basil* of your *Iron*, in such a Position that it may bear upon the whole breadth of the *Basil*; and so working the *Stone* over the *Basil* you will quickly wear the courser grating of the *Grind-stone* off the

edge on that side: Then turn the flat side of the *Iron*, and apply the *Stone* flat to it, till you have worn off the coarse gratings of the *Grind stone*, on that side too.

Joyners often grind their *Irons* upon a flat *Grind-stone* also: And then they hold the *Iron* also in their hands in the same posture as if it were to be ground on the *Round Grindstone*: yet then instead of keeping the *Iron* on one place of the *Stone*, they thrust it hard straight forwards, almost the length of the *Stone*, and draw it lightlier straight back again, keeping it all the while at the same Angle with the superficies of the *Stone*; and then smoothen its edge with the *Whet-stone*, as if it had been ground upon the round *Grind stone*. And this they do so often, till they have rubbed the hollownes of the *Basil* to a flat, and then they grind it again upon the round *Grind-stone*.

This Order and Manner of *Setting, Grinding* and *Smoothing* a *Basil* and *Edge*, is also used in all other *Edge-Tools* Joyners use.

§ 10. of Chissels of several sorts,
And first of Formers.

Formers marked C 1, C 3 are of several sizes. They are called *Formers* because they are used before the *Paring Chissel*, even as the *Fore-Plain* is used before the *Smoothing-Plain*. The *Stuff* you are to work upon being first scribed (as I shall shew in its proper place) you must set the edge of the *Former*, a little without the scribed stroak, with its *Basil* outwards, that it may break and sholder off the Chips from your work as the edge cuts it. And you must bear the *Helve* of the *Former* a little inwards

wards over the *Stuff*, that the *Former* do not at first cut straight down, but a little outwards: For, should you venter to cut straight down at the first, you might with a negligent or unluckly knock with the *Mallet* drive the edge of the *Former* under the work, and so cut before you are aware more off the under side than the upper side of your work, and so (perchance) spoil it. Therefore you may make several cuttings, to cut it straight down by little and little, till your work is made ready for the *Paring Chissel*. When it is used the *Helve* of it is knockt upon with a *Mallet*, to drive the edge into the *Stuff*.

§ II. Of the Paring Chissel.

The *Paring Chissel* C 2. must have a very fine and smooth edge: Its office is to follow the *Former*, and to *pare* off and *smoothen* the irregularities the *Former* made.

It is not knockt upon with the *Mallet*, but the Blade is clasped upon the outside of the hindermost joynts of the four and little fingers, by the clutched inside of the middle and third fingers of the right hand, and so its edge being set upon the *scribed line*, and the top of the *Helve* placed against the hollow of the inside of the right sholder, with pressing the sholder hard upon the *Helve*, the edge cuts and pares away the irregularities.

This way of handling may seem a preposterous posture to mannage an Iron Tool in, and yet the reason of the Original contriver of this posture is to be approved; For, should workmen hold the *Blade* of the *Paring Chissel* in their whole hand, they must either hold their hand pretty near the *Helve* where they

they cannot well mannage the *Tool*, or they must hold it pretty neer the edge, where the outside of the fingers will hide the *scribed line* they are to *Pare* in. But this posture all workmen are at first taught, and Practice doth so inure them to it, that if they would they could not well leave it.

§ 12. *Of the Skew-Former.*

The *Skew-Former* marked C 4 is seldom used by Joyners, but for cleansing accute angles, with its accute Angle on its edge, where the *Angles* of other *Chissels* will not so well come.

§ 13. *Of the Mortefs Chissel.*

The *Mortefs Chissel* marked C 5. is a narrow *Chissel* but hath its *Blade* much thicker, and consequently stronger (that it may endure the heavier blows with the *Mallet*) than other *Chissels* have, so that in grinding it to an edge it is ground to a very broad *Basil*, as you may see in the Figure. Its Office is to cut deep square holes called *Morteffes* in a peice of wood. Joyners use them of several Bredths according as the Bredths of their *Morteffes* may require.

§ 14. *Of the Gouge.*

The *Gouge* marked C 6. is a *Chissel* having a round edge, for the cutting such wood as is to be Rounded or Hollowed.

These several sorts of *Chissels* Joyners have of several sizes, that they may be accomodated to do several sizes of work.

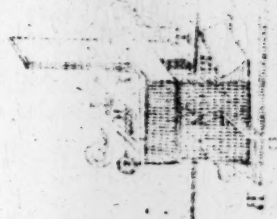
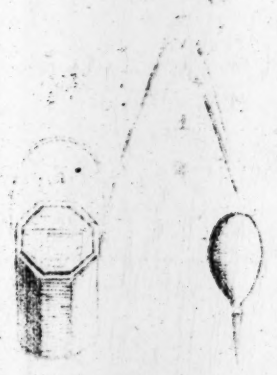
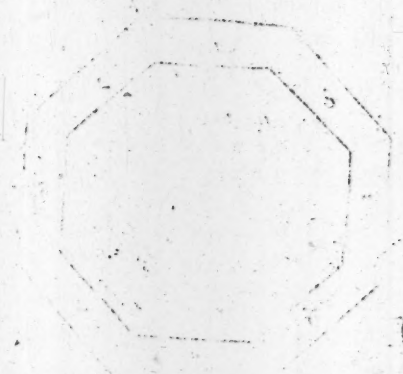
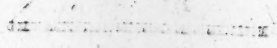
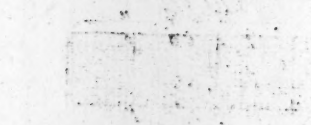
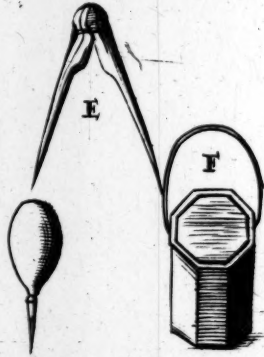
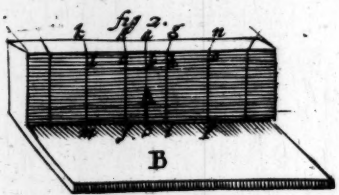
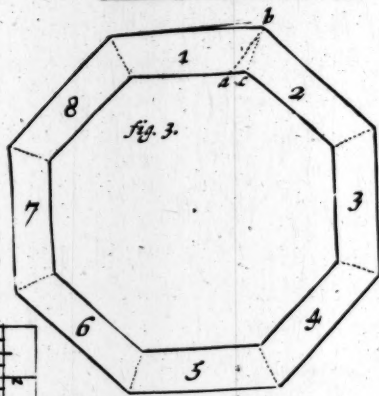
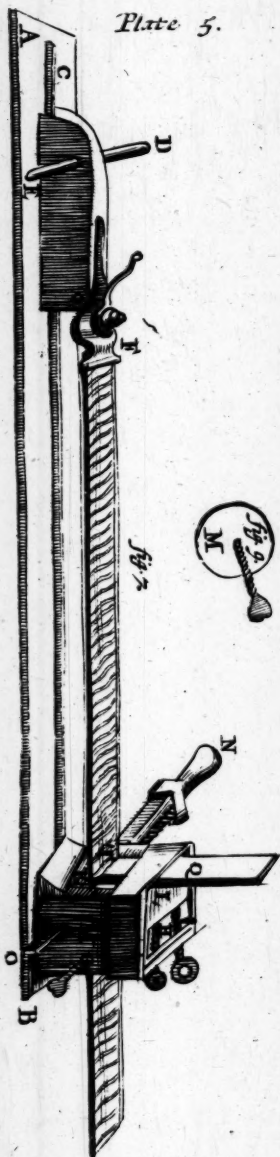


Plate 5.



MECHANICK EXERCISES,

OR,

The Doctrine of
Handy-works,

*From May the 1. to June the 1.
1678. And is intended to be
Monthly continued.*

By *Joseph Moxon* Hydrographer to
the King's most Excellent Majesty.



L O N D O N,
Printed for *Joseph Moxon*, at the Sign of *Atlas* on
Ludgate Hill. 1678.

MECHANICK

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MECHANICK EXERCISES.

O R,

The Doctrine of *Handy-works*.Continued in the Art of *Joynery*.§ 15. *Of the Square, and its Use.*

TH E *Square*, marked D, is two adjunct Sides of a Geometrical Square. *a* The *Handle*, *b* The *Tongue*, *c* The *Outer Square*, *d* The *Inner Square*. For Joyners use it is made of two pieces of wood, the one about an Inch thick and the other about a quarter of an Inch thick: These two pieces are severally shot exactly straight, and have each of their Sides parallel to each of their own Sides. The thick Piece (called the Handle) hath a Mortise in it, as long within a quarter of an Inch as the thin piece (called the Tongue) is broad, and stiffly so wide as to contain the thickness of the Tongue. The Tongue is fastned into the Mortise of the Handle with Glew and wooden Pins, so as the two outer sides (and then consequently the two inner sides) may stand at right angles with one another.

The Reason why the Handle is so much thicker than the Tongue, is because the Handle should on either side become a Fence to the Tongue. And the reason why the Tongue hath not its whole breadth let into the end of the Handle is, because they may with less care strike a line by the side of

N

a thin

a thin than a thick piece : For if instead of holding the hand upright when they strike a line, they should hold it never so little inwards, the shank of a Pricker falling against the top edge of the Handle would throw the Point of a Pricker farther out than a thin piece would: to avoid which Inconvenience the Tongue is left about half an Inch out of end of the Handle.

Another Reason is, That if with often striking the Pricker against the Tongue it becomes ragged, or uneven, they can with less trouble plain it again when the stuff is all the way of an equal strength, than they can if cross-graind should be added to any part of it.

Its use is for the striking of lines square either to other lines or to straight sides, and to try the squareness of their work by; As if they would strike a line square to a side they have already shot; They apply the inside of the Handle close to the side shot, and lay the Tongue flat upon the work, then by the outerside of the Tongue they draw with a Pricker a straight line. This is called *Striking or drawing of a Square*. Or, if they would Try the squareness of a Piece of stuff shot on two adjoining sides, they apply the insides of the Handle and Tongue to the outsides of the stuff, and if the outsides of the stuff do all the way agree in line with the insides of the Square, It is true Square. Or if they would try the inward squareness of work, they apply the two outsides of the Square to the insides of the work.

§ 16. *The manner of Plaining and Trying a piece of Stuff square.*

We will take for Example, a Piece of Stuff called

led a Quarter, which is commonly two Inches thick, four Inches broad, and seven Foot long. To plain this square, Lay one of its broad sides upon the Bench, with one of its ends shov'd pretty hard into the Teeth of the Bench-hook, that it may ly the fteddier. Then with the Fore-Plain as you were taught §2. Numb. 4. Plain off the roughness the Saw made at the Pit, and work that side of the Quarter as straight in its length and breadth as you can with the Fore-Plain; which you may give a pretty good guess at, if the edge of the Iron have born all the way upon the work, yet you may try by taking up your work, and applying one end of it to one Ey while you wink with the other, and observe if any Hollow or Dawks be in the length; if not, you may conclude it pretty true: For the work thus held, the Ey will discern pretty nearly. Or, for more certainty you may apply the edge of the two Foot Rule, or rather a Rule shot the full length of the Quarter to your work, and if it agree all the way with the Rule, you may conclude it is straight in length. But if you finde it not straight, you must still with the Fore Plain work off those Risings that bear the edge of the Rule off any part of the Stuff: Then try if the Breadth be pretty straight, if it be (the Dawks the roughness the Fore Plain made excepted) the first office of the Fore Plain is perform'd: If it be not, you must straighten the Breadth as you did the Length.

But though this Quarter be thus plained straight in length and breadth, yet because the Iron of the Fore Plain for its first working the stuff is set Rank, and therefore makes great Dawks in the stuff, you must set the Iron of your Fore plain finer, as you were

taught § 3. *Numb. 4.* and with it then work down even almost to the bottom of those Dawks : then try it again, as before, and if you find it Try all the way, you may with the Joynter or Smoothing Plain, but rather with the Joynter, go over it again, to work out the irregularities of the fine Fore Plain : For the Iron of the Fore Plain being ground to a Rising in the middle, as has been shewed § 2. *Numb. 4.* though it be very fine set, will yet leave some dawks in the Stuff for the Joynter or Smoothing Plain to work out. Thus the first side of the Quarter will be finished.

Having thus Tried one side of the Quarter straight and flat, Apply the in-side of the Handle to it, and if one of the adjoining sides of the Quarter comply also with the in-side of the Tongue all the way, you need only smooth that adjoining side : But if it do not so comply, that is, if it be not square to the first side, which you will know by the riding of the in-side of the Tongue upon one of the edges, or some other part between the edges, you must with the Fore Plain Rank-set plain away that stuff which bears off the inside of the Tongue from complying all the way with it. But if the risings be great, you may for quickness hew away the Risings with the Hatchet : but then you must have a care you let not the edge of your Hatchet cut too deep into the stuff, lest you either spoil your stuff by making it unsizeable, if it be already small enough ; or if it have substance enough, make your self more labour to get out those Hatchet stroaks with the Plain than you need. Then take off the roughness the Hatchet made with the Fore-Plain Rank-set, then fine set, and last of all with the Joynter

ter or smoothing Plain : so is the second side also finished.

To work the third side, set the Oval of the Gage exactly to that width from the Gage that you intend the Breadth of the Quarter (when wrought) shall have, which in this our Example is four Inches, but will be somewhat less, because working it true will diminish the stuff: Therefore sliding the Oval on the Staff, measure on your Inch Rule so much less than four Inches as you think your stuff diminishes in working: Measure, I say, between the Oval and the Tooth, your size, If at the first proffer your Oval stand too far from the Tooth, Hold the Oval in your hand and knock the Tooth end of your staff upon the work Bench till it stand near enough: If the Oval stand too near knock the other end of the Staff upon the Work-Bench till it be fit. Then apply the flat of the Oval to the second wrought side of your Stuff, so as the Tooth may reach athwart the breadth of the stuff upon the first side, and keeping the Oval close against the second side, press the Tooth so hard down that by drawing the Gage in this Posture all along the length of the Quarter, the Tooth may strike a line. In like manner upon the side opposite to the first, viz. the fourth side, Gage another line opposite to the first gaged line, and work your stuff down to those two Gaged lines on the third side, either with Plaining alone, or with Hewing and afterwards Plaining, as you were taught to work the second side.

To Work the fourth side set the Tooth of the Gage to its exact distance from the Oval, viz. two Inches wanting so much as you think the stuff di-

minisht in working, and apply the flat of the Oval to each side of the first side, and Gage as before two lines, one on the second, the other on the third wrought side. Work your stuff then down on the fourth side to these two Gage lines, either with Plaining alone, or with Hewing and afterwards Plaining, as you were taught to work the second side.

§ 17. *To Frame two Quarters Square, into one another.*

You must take care in Mortessing and Tennanting, that as near as you can you equallize the strength of the sides of the Mortess to the strength of the Tennant. I do not mean that the stuff should be of an equal Substance, for that is not equallizing strength: But the equallizing strength must be considered with respect to the Quality, Position and Substance of the Stuff. As if you were to make a Tennant upon a piece of Fur, and a Mortess to receive it in a piece of Oak, and the Fur and Oak have both the same size. The Tennant therefore made upon this piece of Fur must be considerably bigger than a Tennant need be made of Oak, because Fur is much a weaker wood than Oak, and therefore ought to have a greater Substance to equallize the strength of Oak. And for Position, the shorter the stuff that the Tennant is made on, the less Violence the Tennant is subject to. Besides it is easier to split wood with the grain, than to break wood cross the grain; and therefore the same wood when posited as a Tennant is stronger than the same wood of the same size when posited as a Mortess: for the injury a Mortess is subject to is splitting with the grain of the wood, which without good care it will often do

do in working: but the force that must injure a Tennant must offend it cross the grain of the wood, in which position it will best indure violence.

When two pieces of wood of the same quality and substance (as in this our Example) are elected to make on the one a Tennant, and in the other a Mortefs. If you make the Mortefs too wide, the sides of the Mortefs will be weaker than the Tennant; or, if too narrow, the Tennant that must fit the Mortefs will be weaker than the sides that contain the Mortefs: And if one be weaker than the other the weakest will give way to the strongest when an equal violence is offer'd to both. Therefore you may see a necessity of equallizing the strength of one to the other, as near as you can. But because no Rule is extant to do it by, nor can (for many considerations I think) be made, therefore this equallizing of strength must be referred to the Judgment of the Operator. Now to the work.

The Mortefs to be made is in a Quarter four Inches broad. In this case workmen make the Mortefs an Inch wide, so that an Inch and an half stuff remains on either side it. Therefore your stuff being squar'd as was taught in the last Section, Set the Oval of the Gage an Inch and an half off the Tooth, and gage with it on either side your stuff a straight line at that distance from the end you intend the Mortefs shall be: then open your Compasses to two Inches, and prick off that distance in one of the lines, for the length of the Mortefs: then lay the inside the Handle of the Square to one side of the stuff, and upon both the pricks successively, and with your Pricker draw straight lines through them by the side of the Tongue, so shall the bounds of your Mortefs be struck.

struck out on the Quarter. If your Mortefs go through the Quarter, draw the same lines on the opposite side of the Quarter, thus. Turn the Quarter or its edge, and apply the inside of the Handle of the Square to the ends of the former drawn lines, and by the side of the Tongue draw two lines on the edge of the Quarter, then turn the Quarter again with its other broad side upwards, and apply the inside of the Handle of the Square to the ends of the last lines drawn on the edge, and by the side of the Tongue draw two lines on this broad side also. These two lines (if your quarter was truly squar'd) shall be exactly opposite to the two lines drawn on the first broad side of the quarter, for the length of the Mortefs: And for the width of the Mortefs Gage this side also, as you did the first: then for the Tennant, Gage on that end of the Quarter you intend the Tennant shall be made, the same lines you did for the Mortefs. And because the Quarter is two Inches thick, prick from the end two Inches, and applying the inside of the Handle of the Square to the side of the Quarter, and the Tongue to that Prick, draw by the side of the Tongue a line through that side the Quarter: then turn the other sides of the Quarter successively, and draw lines athwart each side the Quarter, as you were taught to draw the opposite lines for the Mortefs.

Then place the edge of the Inch Mortefs Chissel with its Basil from you, and the Helve bearing a little towards you, within one half quarter of an Inch of one end of the struck Mortefs, and with your Mallet knock hard upon it, till you find the Basil of the Chissel will no longer force the chips out of the Mortefs: then remove the Chissel to the other end
of

of the Mortefs, and work as with the first end, till the Chips will void no longer : Then work away the Stuff between the two Ends, and begin again at one of the ends, and then at the other, and work deeper into the Mortefs ; then again between both ; and so work deeper by degrees, till you have wrought the Mortefs through, or (if not through) to the intended depth : then with the Mortefs Chissel work nearer the drawn lines at the ends of the Mortefs (for before you were directed to work but within half a quarter of an Inch of the drawn lines,) by laying light blows on it, till you have made it fit to pare smooth with a narrow Paring Chissel, and then pare the ends, as you were taught to work with the Paring Chissel : then with the broad Paring Chissel, pare the sides of the Mortefs just to the struck lines ; so is the Mortefs finished.

To work the Tennant lay the other Quarter on edge upon your Work Bench, and fasten it with the Holdfast, as you were taught Sect. I. Then with the Tennant Saw Saw a little without the struck line towards the end : you must not Saw just upon the struck line, because the Saw cuts rough : Besides, you must leave some stuff to pare away smooth to the struck line, that the *Stile* (that is, the upright Quarter) may make a close Joynt with the *Rail* (that is) the lower Quarter : Saw therefore right down with the Tennant Saw, just almost to the gaged lines for the thickness of the Tennant, and have a care to keep the Blade of the Saw exactly upright. Then turn the opposite side of the Quarter upwards, and work as you were taught to work the first side.

Then with the paring Chissel ; pare the work
 O close

close to the gaged lines for the Tennant. Then try how it fits the Mortels: If it be not pared enough away, you must Pare it where it Bears, that is, sticks. But if you should chance to have made it too little, you have spoiled your work: Therefore you may see how necessary it is not to make the Mortels too wide at first, or the Tennant too narrow.

Then with the Piercer pierce two holes through the sides or cheeks of the Mortels, about half an Inch off either end one. Then knock the Tennant stiff into the Mortels, and set it upright by applying the angle of the outer square to the angle the two Quarters make, and with your Pricker prick round about the insides of the Pierced holes upon the Tennant. Then take the Tennant out again, and Pierce two holes with the same Bit about the thickness of a shilling above the Pricked holes on the Tennant, that is, nearer the sholder of the Tennant, that the Pins you are to drive in may draw the sholder of the Tennant the closer to the flat side of the Quarter the Mortels is made in. Then with the Paring Chissel make two Pins somewhat Tapering, full big enough, and setting the two Quarters again square as before, Drive the Pins stiff into the Pierced holes.

If you make another Square as you did this, and make also a Tennant on each un-Tennanted end of the Stiles, and another Mortels on the top and bottom Rails, you may put them together and make square Frame of them.

§ 18. *Of the Miter Square. And its Use.*

The Miter square marked E hath (as the Square) an Handle marked a one Inch thick, and three Inches

es broad, and a Tongue marked *b* of about the same breadth: the Handle and the Tongue (as the Square) have both their sides parallel to their own sides. The Handle (as the square) hath in the middle of its narrowest side a Mortise in it, of an equal depth the whole length of the Handle: Into this Mortise is fitted one end of the Tongue, but the end of the Handle is first Bevelled off to make an Angle of 45 Degrees with its inside. This Tongue is (as the Square) Pinned and Glued into the Mortise of the Handle.

It is used for striking a Miter line, as the Square is to strike a square line, By applying the Inside of the Handle to the outside of the Quarter or Batten, you are to work upon: and then by striking a line by the side of the Tongue: For that line shall be a Miter line. And if upon two Battens you strike two such lines, and Saw and Pare them just off in the lines, when the flatts of those two sawn ends are applied to one another, the out and inside of the Battens will form themselves into the Figure of a Square.

Thus Picture Frames and looking Glass-frames are commonly made, as by a more full Example you may see in the next Section.

§ 19. *Of the Bevil.*

As the Square is made to strike an Angle of 90 Degrees, and the Miter an Angle of 45 degrees, so the Bevil (marked *F*) having its Tongue movable upon a Center may be set to strike angles of any greater or lesser numbers of Degrees, according as you open the Tongue wider from, or shut it closer to the Handle. It is used as the Square, and the Miter, and will perform the Offices of them both, though it be not purposely made for either; but for

the striking such Bevil lines as one part of your work must be cut away to, to make it joyn with another part of your work : for Example.

We will propose to make a Frame for a Picture, Looking Glafs, &c. containing eight straight sides; You may quickly perceive that all the ends of these eight sides must be cut to Bevils; and what Bevils they must be, you will find if you describe upon a smooth flat Board a Circle of any bigness, but the larger the beter : Devide this Circle into eight equal parts, and from every point draw a line to the Center : Draw also straight lines from every point to its next point : Then lay the Inside of the Handle of your Bevil exactly upon any one of these straight lines, so as the angle made by the inside of the Handle and the inside of the Tongue lye exactly at the very angle made by this straight line, and the Semi-Diametral line proceeding from the Center, and move the Tongue nearer or farther off the Handle till the inside of the Tongue and the inside of the Handle ly exactly upon those two lines, So shall your Bevil be set.

Then having fitted your Peeces to your Scantling, Stick your Pricker as neer the outward Corner of your Peeces as your stuff will bear, and apply the inside of your handle also to the outer sides of your Pieces, and so as the inside of the Tongue may be drawn home to the Pricker. For then lines drawn on those Peeces by the inside of the Tongue shall be the lines the Pieces must be cut in to make these eight Pieces joyn evenly together by the sides of each others Bevil : then with the Strike-block smooth the ends of the Bevils, as you were taught in the Section of the Strike-Block.

If you have a Board on the Back-side of this
Frame

Frame, you may Glew the backside of these Peeces Peece by Peece to the Board ; but first you must fit them to an exact compliance of every Bevil with its Match, and when they are so fitted, drive two Nails close to the outside of every Peece, but drive not the Nails deep into the Board, because when the Frame is set and Glewed, or othwise fastned, you must draw the Nails out again, For these Nails are only intended to serve for Fences to set and fit each peece into its proper place, before the whole Frame is fastned together. And should you not thus Fence them, though by your Eye you might judge you fitted the Bevils exactly, yet one Peece being never so little out of its due position would drive the next peece more out, and that the next, till at the last, the last Peece would not joyn, but either be too short, or too long, or stand too much out, or in, or else too open, or too close on the out or inside.

But if you have no Board on the backside, you must when you Saw the Bevelling angles upon the square ends of Pieces not sawn quite through the depth of one end of every peece, but about half way through the depth or thickness, and then with your Chissel either split or else pare the upper side of the square end flat away to the Bevil, and so leave part of the square end of your piece to lap under the peece is joyned to. For Example.

In fig. 3 Plate 5. *a b* is the square end of the peece, and *b c* is the Bevil you work the Peece to. Therefore you must work away so much of the thickness of the square end as is comprehended between *a* and *c*, so that you will see the Triangle *a b c* is to be wrought away half way down the thickness

of the stuff, and so will the Triangle *abc* be left for the other half thickness of the stuff. But that end of the piece mark'd 1, which joyns to the Peece mark'd 2, must upon its Bevil stroak be sawn quite off, and its underside must have the same Triangle wrought into it, just so fit as to receive the Triangle in Peece 2, and just so deep as that when the Triangle on Peece 2 is fitted into the Triangle in Peece 1 the Superfici- es of both the Peeces may be even with one another. And thus you may lap the ends of every Peece into one another.

These Triangles at the ends of the Peeces you may Glew into one another, but if you think Glewing alone not strong enough, you may Pierce an hole neer the inner edge of the Frame, because the Triangle hath there most substance of stuff; and afterwards Pin it, as you are taught to Pin the Rail and Scile together in Sect. 17.

This way of Lapping over is sometimes used also for square Miters, or other Angular Frames.

§. 20. *Of the Miter Box.*

There is another way used by Joiners that make many Frames to save themselves the labour of Drawing or striking out of Squares, Miters, and several Bevils upon their stuff: And this is with a Tool called a *Miter Box*, described in Plate 5. fig. 2. It is composed of two Peeces of Wood, of an Inch thick each, as *A* the upright Peece, *B* the Bottom Piece. The Upright piece is nailed upright, fast upon the Bottom Piece. And this Upright Peece hath on its upper side the Miter Lines struck with the Miter Square, as *de*, on the left hand, and *gh* on the right hand: on these two Miter lines the edge of

of the Saw is set, and a kerf made straight down the upright peece, as from *d e* on the left hand to *f*, and from *g h* on the right hand to *i*. In like manner any other Bevil is struck upon the upper side of the upright peece with the Bevil, as *k l* on the left hand, and *n o* on the right. On these two Bevil lines the edge of the Saw is set, and a kerf made straight down the upright peece, as from *k* to *l m*, and from *g h* to *i*. You may make as many Bevils as you please on the upright peece, of the Miter Box; Bevils to joyn Frames of either five, six, seven, eight sides &c. and the manner to make them to any number of sides was in part taught in the last Section. For as there you were directed to divide the Circle into eight equal parts, because eight was the number of sides, we proposed to make that Frame consist of; So, if for any number of sides you divide the Circle into the same equal parts, and work as you were there directed, you may find what Bevil the Peeces must have that make a Frame that consists of any number of sides.

So also for Sawing of any Batten, or other small pieces square; Strike at the point *a* on the upper side of the upright Peece a line straight athwart it, to *b*, and Saw straight down the upper peece, to *a*.

The manner how these kerfs are Sawed straight down with greatest certainty is, thus, Apply the inside of the Handle of the square to the upper side of the upright piece, so as the Tongue lye close to that end of the Miter, Bevil, or square line struck through the upper side of the Miter Box, and with the Picker strike a line close by the side of the Tongue through that side of the upright Peece. Turn the Tongue to the other side the upright Peece.

Peece and apply the inside of the Handle of the square to the other end of the Miter, Bevil, or square line, and with the Pricker strike also a line close by the side of the Tongue through that side the upright Peece. These two lines struck on either side of the upright peece shall be a line on each side in which the edge of the Saw must run, to saw it straight down.

§ 21. *Of the Gage.*

The *Gage* mark'd *G* (in *Plate 4*.) The *Oval b* is fitted stiff upon the *Staff c*, that it may be set nearer or farther from the *Tooth a*. Its Office is to *Gage* a line parallel to any straight side. It is used for *Gaging* Tennants, and for *Gaging* Stuff to an equal thickness.

When you use it, you must set the *oval* to the intended Distance from the *Tooth*: If the *Oval* stand too near the *Tooth*, Hold the *Oval* in your right hand, and knock the hinder end of the *Staff* upon the work bench, till it remove to its just distance from the *Tooth*: If it stand too farr off the *Tooth*, knock the fore end of the *Staff* (viz. the *Tooth* end) till it remove to its just distance from the *Tooth*: If the *Oval* slide not stiff enough upon the *Staff*, you may stiffen it by striking a wooden wedge between the *Mortels* and the *Staff*: So may you apply the side of the *Oval* next the *Tooth*, to the side of any Table or any other straight side, with the *Tooth Gage* a line parallel (or of equal distance) all the way from that side.

§ 22. *Of the Piercer.*

The *Piercer H* in *Plate 4* hath *a* the *Head*, *b* the *Pod*,
c the

c the *Stock*, d the *Bit*. Its office is so well known, that I need say little to it. Only, you must take care to keep the Bit straight to the Hole you pierce, least you deform the Hole, or break the Bit.

You ought to be provided with Bitts of several sizes, fitted into so many Padds.

§ 23. Of the Gimblet.

The *Gimblet* is marked I, in *Plate 4*. It hath a Worm at the end of its Bit. Its Office is to make a round hole in those places of your work where the *stock* of the Piercer by reason of its own sholder, or a sholder or Butting out upon the work will not turn about. Its Handle is held in a clutched hand, and its Bit twisted stiff into your work. You must have them of several sizes.

§ 24. Of the Augre.

The *Augre* marked K in *Plate 4*. hath a a the Handle, b the *Bit*. Its Office is to make great round holes. When you use it, the stuff you work upon is commonly laid low under you, that you may the easier use your strength upon it: For in twisting the Bit about by the force of both your hands, on each end of the Handle one, it cuts great chips out of the stuff. You must bear your strength perpendicularly straight to the end of the Bitt; as with the Piercer.

§ 25. Of the Hatchet.

The *Hatchet* is marked L, in *Plate 4*. Its use is so well known (even to the most un-intelligent) that I need not use many words on it, yet thus much I will say, Its use is to Hew the irregularities off such

such peeces of stuff which may be sooner Hewn than Sawn.

When the Edge is downwards and the Handle towards you, the right side of its Edge must be Ground to a Bevil, so as to make an Angle of about 12 degrees with the left side of it: and afterwards set with the whetstone, as the Irons of Plains, &c.

§ 26. *The Use of the Saw in general.*

In my former *Exercises* I did not teach you how to chuse the Tools a Smith was to use, Because it is a Smiths office to make them: And because in those *Exercises* I treated of making Iron work, and Steel work in general, and the making and excellency of some Tools in particular, which might serve as a general notion for the knowledge of all Smiths Workmanship, especially to those that should concern themselves with Smithing: But to those that shall concern themselves with Joynery, and not with Smithing; It will be necessary that I teach them how to choose their Tools that are made by Smiths, that they may use them with more ease and delight, and make both quicker and neater work with them.

All sorts of saws for Joyners use are to be sold in most Iron-monger shops, but especially in *Foster-lane, London*: chuse those that are made of Steel, (for some are made of Iron) for Steel is of it self is harder and stronger than Iron: You may know the Steel Saws from Iron Saws, Thus, The Steel Saws are generally ground bright and smooth, and are (the thickness of the Blade considered) stronger than Iron Saws: But the Iron Saws are only Hammer-hardned, and therefore if they could be so hard, yet they

they cannot be so smooth as if the irregularities of the Hammer were well taken off with the Grindstone : see it be free from flaws, and very well Hammered, and smoothly Ground, (that is evenly Ground,) you may know if it be well Hammered by the stiff bending of it, and if it be well Ground, (that is evenly Ground,) it will not bend in one part of it more than in another ; for if it do, it is a sign that part where it bends most is either too much Ground away, or too thin Forged in that place : But if it bend into a regular bow all the way, and be stiff, the Blade is good : It cannot be too stiff, because they are but Hammer hardened, and therefore often bow when they fall under unskilful hands, but never break, unless they have been often bowed in that place. The edge whereon the Teeth are is always made thicker than the back, because the back follows the Edge, and if the Edge should not make a pretty wide kerf, if the back do not stick in the kerf, yet by never so little irregular bearing or twisting of the hand awry, it might so stop as to bow the *Saw* ; and (as I said before) with often bowing it will break at last. When workmen light of a good Blade thus qualified, they matter not much whether the Teeth be sharp or deep, or set to their mind ; for to make them so is a task they take to themselves, And thus they perform it : They wedge the blade of the *Saw* hard into the *Whetting Block*, marked P, in *Plate 4*, with the handle towards their left hand, and the end of the *Saw* to the right, then with a three-square file they begin at the left hand end, leaning harder upon the side of the file on the right hand than on that side to the left hand ; so that they file the upper side of the Tooth of the *Saw* aslope towards the right hand,

and the underfide of the Tooth a little aflope towards the left, or almost down-right. Having filed one Tooth thus, all the reft must be fo filed: Then with the *Saw wrest*, marked O in *Plate 4.* they *set* the Teeth of the Saw: that is, they put one of the Notches marked *a a* of the *Wrest* between the first two Teeth on the Blade of the *Saw*, and then turn the Handle Horizontally a little about upon the Notch towards the end of the *Saw*; and that at once turns the first Tooth somewhat towards you, and the second Tooth from you: Then skipping two Teeth, they again put one of the notches of the *Wrest* between the third and fourth Tooth on the Blade of the *Saw*, and then (as before) turn the Handle a little about upon the notch towards the end of the *Saw*, and that turns the third Tooth somewhat towards you, and the Fourth somewhat from you: Thus you must skip two Teeth at a time, and turn the *Wrest* till all the Teeth of the *Saw* are *set*. This *Setting* of the Teeth of the *Saw* (as workmen call it) is to make the kerf wide enough for the Back to follow the edge: and is *Set Ranker* for soft, course, cheap stuff than for hard, fine, and costly stuff: for the *Ranker* the Tooth is *set*, the more stuff is wasted in the kerf: and besides, if the stuff be hard it will require greater labour to tear away a great deal of hard stuff, then it will do to tear away but a little of the same stuff.

The *Pit-Saw*, is *set* so Rank for course stuff as to make a kerf of almost a quarter of an Inch, but for fine and costly stuff they *set* it finer to save stuff, The *Whip-Saw* is *set* somewhat finer than the *Pit-Saw*, the *Hand-Saw*, and the *Compass-Saw*, finer than the *Whip-Saw*; But the *Tennant Saw*, *Frame-saw*, and the *Bow Saw*, &c. are *set* fine and have

have their Teeth but very little turned over the sides of their Blades ; So that a kerf made by them is seldom above half a half quarter of an Inch.

The reason why the Teeth are filed to an angle, pointing towards the end of the *Saw*, and not towards the handle of the *Saw*, or directly straight between the handle and end of the *Saw*, is, Because the *Saw* is designed to cut only in its progress forwards; Man having in that activity more strength to rid, and Command of his hands to guide his Work, than he can have in drawing back his *Saw*, and therefore when he draws back his *Saw*, the Work-man bears it lightly off the unsawn *Stuff*, which is an ease to his labour, and enables him the longer to continue his several Progressions of the *Saw*.

Master-Workmen when they direct any of their Underlins to saw such a piece of *Stuff*, have several phrases for the sawing of it: They seldom say *Saw that piece of Stuff*; But *Draw the Saw through it*; *Give that piece of Stuff a kerf*; *Lay a kerf in that piece of Stuff*; and sometimes, (but most improperly,) *Cut*, or *Slit that piece of Stuff*: For the *Saw* cannot properly be said to cut or slit the *Stuff*; but it rather breaks or tears away such parts of the *Stuff* from the whole, as the points of the Teeth prick into, and these parts it so tears away are proportionable to the fineness or rankness of the Setting of the Teeth.

The Excellency of Sawing is to keep the kerf exactly in the line marked out to be Sawn, without wriggling on either or both sides; And straight through the *Stuff*, as Work-men call it; that is, in a Geometrical term perpendicularly through the upper and under side, if your work require it, as
most

most work does : But if your work be to be Sawn upon a Bevel, as some work sometimes is, then you are to observe that Bevel all the length of the Stuff, &c.

§ 27. *The Use of the Pit-Saw, marked M in Plate 4.*

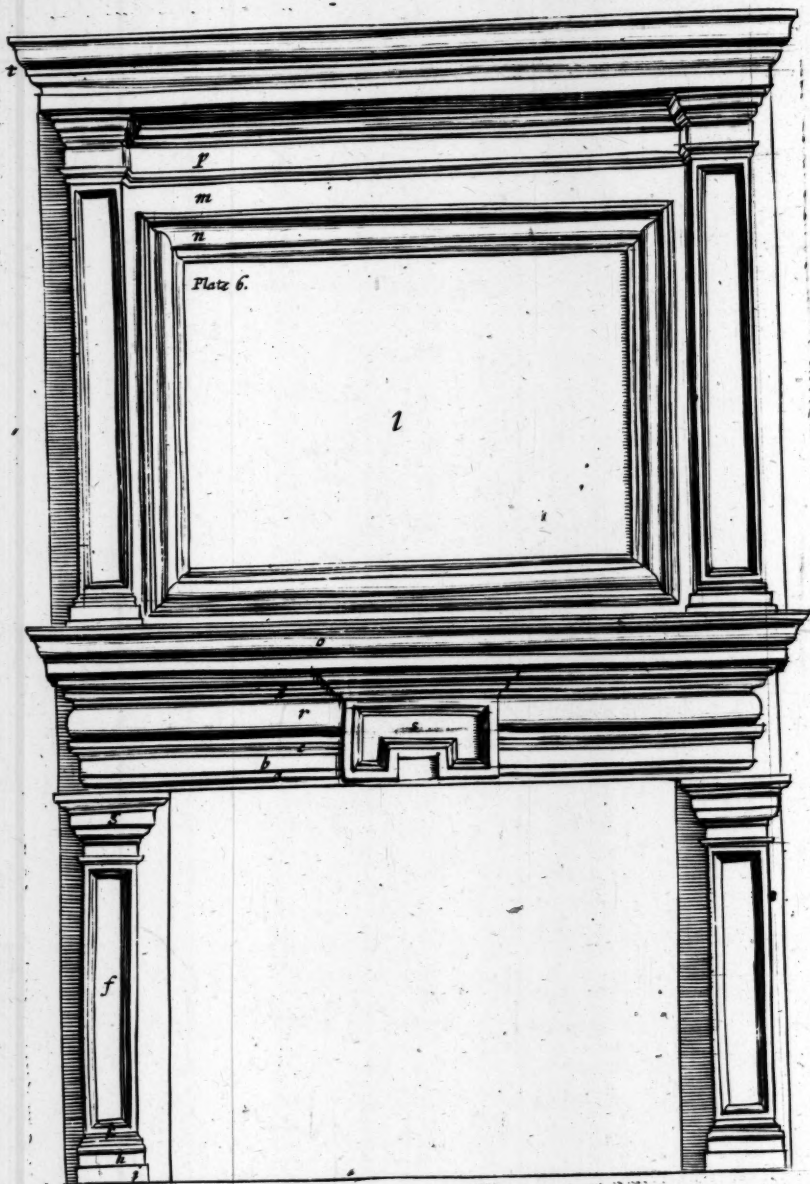
The *Pit-Saw* is not only used by those Work-men that make Sawing Timber and Boards their whole business, but is also for small matters used by Joyners, when what they have to do, may perhaps be as soon done at home, as they can carry or send it to the Sawyers. The manner of their working is both alike, for if it be a Board they would slit off a peece of Timber, or if they would take any square, Quarter, or Batten, &c. off, they first set off their Scantlin : For Example, If it be an Inch (or more or less) they would take off a peece of Stuff, they open the points of their Compasses to an Inch measure on their Rule, and so much more as they reckon the kerf of the *Saw* will make, and from one side of their Stuff they set off at either end of the Stuff the Distance of the points of their Compasses ; at this Distance therefore they make with the points of their Compasses a prick at either end of the Stuff ; Then with Chaulk they whiten a line, by rubbing the Chaulk pretty hard upon it ; Then one holds the line at one end upon the prick made there, and the other strains the line pretty stiff upon the prick at the other end ; then whiles the line is thus strain'd, one of them between his Finger and Thumb draws the middle of the line directly upright, to a convenient height (that it may spring hard enough down) and then lets it go again, so that it swiftly applies to its first position.

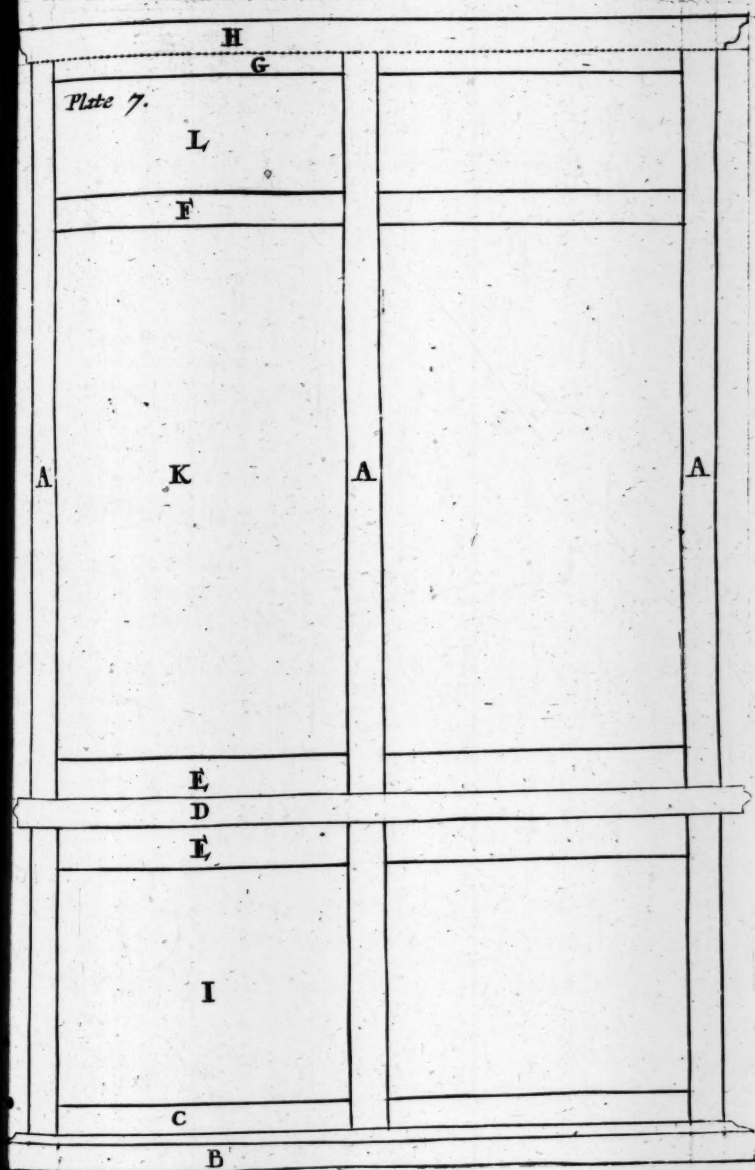
tion, and strikes so strongly against the Stuff that the dust or attoms of the Chaulk that were rubbed into the Line, shake out of it, and remain upon the Stuff. And thus also they mark the under-side of their Stuff: This is called *Lining of the Stuff*: And the Stuff cut into those lines shall be called *Inch-Stuff*, because the Compasses that prickt the Stuff were opened wider by the width of the kerf than an Inch measure upon the Rule: But had the Compasses been opened but to an Inch exactly, that peece Sawn off should in Workmens Language have been called *Inch prickt*, thereby giving to understand that it is half the breadth of the kerf thinner than an Inch: And thus they call all other Scantlins *2 Inches, 2 $\frac{1}{2}$ Inches, 3 Inches, &c. Sawn, or Prickt.*

When two Work-men are not at hand to hold the line at both ends, he that lines it strikes one point of his Compass, or sometimes a Pricker, or a Nail aslope towards that end into the prick set off, and putting the noose at the end of his line over his Compasses, &c. goes to the other end, and strains his line on that prick, and strikes it as before.

The Stuff being thus lined is fastned with wedges over the *Pit*, (if the Joyner be accommodated with a *Pit*) if he have none, he makes shift with two high frames a little more than Man high in its stead, (called *great Trussels*) with four Legs, these Legs stand spreading outwards, that they may stand the firmer: Over these two *Trussels* the Stuff is laid and firmly fastned that it shake not. Its outer side from whence the Pricks were set off must be Perpendicular, which you must try by a Plumb line, for should the top edge of that side, hang never so little over the bottom edge, or the bottom edge
not

not ly so far out as the top edge, the Scantlin you Saw off would not be of an equal thicknes on the Top or Bottom; Because the Saw is to work exactly perpendicular. Then with the *Pit-Saw* they enter the one end of the Stuff, the *Top man* at the Top, and the *Pit-man* under him; the *Top-man* observing to guide the *Saw* exactly in the line; and withal drawing the *Saw* somewhat towards him when the *Saw* goes down; and the *Pit-man* drawing it with all his strength perpendicularly down; but not so low that the upper and lower handles of the *Saw* sink below both their managements: Then bearing the Teeth of the *Saw* a little off the Stuff, the *Top-man* draws the *Saw* up again, and the *Pit-man* assists or eases him in it, and thus they continue sawing on till the *Saw* has run through the whole length upon the Stuff. But when the kerf is made so long that by the working of the *Saw* the Peeeces of Stuff on either side will shake against one another, and so more or less hinder the easie progress of the *Saw*, they drive a Wedge so far in the kerf as they dare do for fear of splitting the Stuff, and so provide the *Saw* a freer and easier passage through the Stuff: This wedging they continue so oft as they find occasion.





5

MECHANICK EXERCISES,

OR,

The Doctrine of
Handy-works,

*From June the 1. to July the 1.
1678. And is intended to be
Monthly continued.*

By *Joseph Moxon* Hydrographer to
the King's most Excellent Majesty.



L O N D O N,

Printed for *Joseph Moxon*, at the Sign of *Atlas* on
Ludgate Hill. 1678.

MEMORANDUM

EXERCISE

OF

The Doctrine of

THE DOCTRINE OF

From June 1st to 1st 1878
The doctrine of the
doctrine of the

The doctrine of the
the doctrine of the

Printed for the
at the

MECHANICK EXERCISES.

O R,
The Doctrine of *Handy-works*.Continued in the Art of *Joynery*.§ 28. *The Use of the Whip-Saw, marked N in Plate 4.*

THE *Whip-Saw* is used by Joyners to Saw such greater peeces of Stuff that the *Hand-Saw* will not easily reach through; when they use it the Stuff is laid upon the *Trussel*, marked O in *Plate 5*. in the Angles of it. Then two men takes each an handle of the *Saw*; He to whom the Teeth of the *Saw* points, drawing to him, and the other thrusting from him: And (as before) the *Saw* having run its length, is lifted gently over the Stuff to recover another stroak of the *Saw*.

§ 29. *The use of the Hand-Saw, marked D, the Frame or Bow Saw, the Tennant-Saw, marked O in Plate 4.*

These *Saws* are accommodated for a single mans use, and cut forward as the other *Saws* do. The office of the Cheeks made to the *Frame-Saw* is, by the twisted Cord and Tongue in the middle to draw the upper ends of the Cheeks closer together that the lower end of the Cheeks may be drawn the wider asunder, and strain the Blade of the *Saw* the straighter. The *Tennant Saw* being thin hath a Back to keep it from bending.

Q

§ 30. *The*

§ 30. *The Use of the Compass-Saw, marked Q Plate 4.*

The *Compass-Saw* should not have its Teeth *Set*, as other *Saws* have ; but the edge of it should be made so broad, and the back so thin, that it may easily follow the broad edge, without having its Teeth *Set*; for if the Teeth be *Set*, the blade must be thin, or else the Teeth will not bow over the Blade, and if it be thin, (considering the Blade is so narrow) it will not be strong enough to abide tough work, but at never so little an irregular thrust, will bow, and at last break ; yet for cheapness, they are many times made so thin that the Teeth require a setting. Its office is to cut a round, or any other Compass kerf ; and therefore the edge must be made broad, and the back thin, that the Back may have a wide kerf to turn in.

§ Of the Rule marked D in Plate 5.

The use of the *Rule* is to measure Feet, Inches, and parts of Inches, which for that Purpose are marked upon the flat and smooth sides of the *Rule*, and numbred with Inches, and hath every Inch divided into two halves, and every half into two quarters, and every quarter into two half quarters ; so that every Inch is divided into eight equal parts, And these Inches are numbred from one end of the *Rule* to the other ; which commonly is in all 24 Inches : which is a Two Foot *Rule*.

They have commonly both Board and Timber measure, &c. marked upon them, for the finding both the superficial and solid Content of Board or Timber : The use of which Lines and Tables having been often taught by others, and being more
Ma-

Mathematical than Mechanical, is unproper for me to meddle with in this Place: but rather to refer to those Books.

But the manual use of it is, either to measure length with it, or to draw a straight line by the side of it, or to Try the straightness or flatness of their Work with. They Try their work by applying one of its edges to the flat of the wrought side of their Work, and bring their Eye as close as they can, to see if they can see light between the edge of the *Rule* and their Work: If they cannot they conclude their work is *Try*, and well wrought.

§ 32. *Of the Compasses marked E in Plate 5.*

aa The *Joynt*, *bb* the *Cheeks* of the Joynt, *cc* the *Shanks*, *dd* the *Points*. Their Office is to describe Circles, and set off Distances from their Rule, or any other measure, to their Work.

§ 33. *Of the Glew-pot marked F in Plate 5.*

The *Glew-pot* is commonly made of good thick Lead, that by its substance it may retain a heat the longer, that the *Glew* *Chill* not (as Work-men say when it cools) when it is to be used.

§ 34. *Of Chusing and Boyling Glew.*

The clearest, dryest and most transparent Glew is the best: when you boyl it, break it with your Hammer into small peeces, and put it into a clean Skiller or Pipkin, by no means greasie, for that will spoil the clamminess of the Glew, put to it so much Water as is convenient to dissolve the Glew, and to make it when it is hot about the thickness of the white of an Egg: the quantity of water can-

not be assigned, because of the different quality there is in Glew : keep it stirring while it is melting, and let it it not stick to the sides or bottom of the Vessel : When it is well boyled, pour it into your Glew-pot to use, but let your Glew-pot be very clean. When it is cold, and you would heat it again in your Glew-pot, you must take great care that it burn not to the sides or bottom of the Glew-pot, for that burning either turns to a thick hard skin, or else to a burnt Cinder-like Substance, which if it mingle with the Glew will spoil it all ; because by its Substance it will bear the two Joynts you are to Glew together, off each other.

When (with often heating) the Glew grows too thick, you may put more water to it ; but then you must make it very hot, lest the Glew and water do not wholly incorporate.

Some Joyners will (when their Glew is too thick) put Small Beer into it thinking it strengthens it: I have tryed it, and could never find it so, but think it rather makes the Glew weaker, especially if the Small Beer chance to be new, and its Yest not well settled from it, or so stale that it be either Dreggy, or any whit mingled with the settlings of the Cask.

§ 35. Of using the Glew.

Your Glew must be very warm, for then it is thinnest, and as it chills it thickens : with a small Brush you must smear the Glew well upon the Joynt of each peece you are to Glew together ; And before you set them as they are to stand, you must jostle them one upon the other, that the Glew may very well touch and take hold of the Wood ; and that

that the Glew on each Joynt may well incorporate. Then fit the two Joynts as they must stand; And when you set them by to dry, let the one stand upright upon the other; For if they stand aslope, the weigh of the Stuff when it leans upon two extreme edges, may make one end of the Joynt *Open*.

§ 36. *Of the Waving Engine.*

The *Waving Engine* described in *Plate 5. Fig. 7.* Hath A B a long square Plank, of about seven Inches broad, five Foot long, and an Inch and half thick: All along the length of this Planck on the middle between the two sides runs a *Rabbet*, as part of it is seen at C: upon this *Rabbet* rides a *Block* with a *Groove* in its under side: This *Block* is about three Inches square and ten Inches long, having neer the hinder end of it a wooden Handle going through it, of about one Inch Diameter, as D E: At the Fore-end of this *Block* is fastned a Vice, somewhat larger than a great Hand-Vice, as at F: The *Groove* in the *Block* is made fit to receive the *Rabbet* on the *Planck*.

At the farther end of the *Plank* is erected a square strong peece of Wood, about six Inches high, and five Inches square, as G. This Square Peece hath a square wide Mortise in it on the Top, as at H. upon the top of this square peece is a strong square flat Iron Coller, somewhat loosely fitted on, having two Male screws fitted into two Female Screws, to screw against that part of the Wooden Peece un-mortessed at the Top, marked L, that it may draw the Iron Coller hard against the Iron marked Q and keep it stiff against the fore-side of the un-mortessed Peece, marked L, when the peece
Q is

Q is set to its convenient height; and on the other side the square wooden Peece is fitted another Iron screw having to the end of its shank fastned a round Iron Plate which lies within the hollow of this wooden Peece, and therefore cannot in Draft be seen in its proper place; But I have described it a part, as at **M** (fig. 9.) Its Nut is placed at **M** on the wooden Peece. On the farther side of the Wooden Peece is fitted a Wooden screw called a *Knob*, as at **N**. Through the farther and hither side of the square Wooden Peece is fitted a flat Peece of Iron, about three quarters of an Inch Broad, and one quarter of an Inch thick, standing on edge upon the Planck; but its upper edge is filed round: (the reason you will find by and by:) Its hither end comes through the wooden Peece, as at **O**, and its farther end on the opposite side of the wooden Peece.

Upright in the hollow square of the wooden peece stands an *Iron*, as at **Q**, whose lower end is cut into the form of the Molding you intend your work shall have.

In the fore side of this wooden Peece is a square hole, as at **R**, called the *Mouth*.

To this Engine belongs a thin flat peece of Hard wood, about an Inch and a quarter broad, and as long as the Rabbet: It is disjunct from the Engine, and in fig. 8. is marked **SS**, called the *Rack*. It hath its under flat cut into those fashioned waves you intend your work shall have: The hollow of these waves are made to comply with the round edge of flat Plate of Iron marked **O** (described before) for when one end of the Riglet you wave, is with the Vice Screwed to the plain side of the Rack, and the other end put through the
Mouth

Mouth of the wooden Peece, as at T T, so as the hollow of the wave on the under-side of the Rack may ly upon the round edge of the flat Iron Plate set on edge as at O, and the Iron Q is strong fitted down upon the Riglet, Then if you lay hold of the Handles of the Block D E, and strongly draw by them, the Rack and the Riglet will both together slide through the Mouth of the wooden Peece: And as the Rounds of the Rack ride over the round edge of the flat Iron, the Rack and Riglet will mount up to the Iron Q, and as the Rounds of the Waves on the under side of the Rack slides off the Iron on edge, the Rack and Riglet will sink, and so in a progression (or more) the Riglet will on its upper side receive the form of the several waves on the under side of the Rack, and also the form or Molding that is on the edge of the bottom of the Iron, and so at once the Riglet will be both Molded and waved.

But before you draw the Rack through the Engine you must consider the office of the Knob N, and the office of the Iron Screw M, For by them the Rack is screwed evenly under the Iron Q. And you must be careful that the Grove of the Block slip not off the Rabbet on the Planck: For by these Screws and the Rabbet and Grove your work will be evenly gaged all the way (as I said before) under the edge of the Iron Q, and keep it from sliding either to the right or left hand, as you draw it through the Engine.

§ 37. *Of Wainscoting Rooms.*

AAA (in *Plate 7.*) The *Stiles*. B The *Base*,
C The *Lower-Rail*. D The *Sur-Base*. E E The
Mids

Middle Rail (or *Rails*) F The *Frieze-Rail*. G The *Upper-Rail*. H The *Cornice*. I The *Lying Pannel*. K The *Large Pannel*. L The *Frieze Pannel*.

In Wainscoting of Rooms there is, for the most part, but two heights of Pannels used; unless the Room to be Wainscoted be above ten foot high, as some are eleven or twelve foot High, and then three Heights of Pannels are used: As I The *Lying Pannel*, above the *Base*. K The *Large Pannel* above the *Middle Rail*: And L The *Frieze Pannel* above the *Frieze Rail*.

The *Frieze Rail* is to have the same breadth the *Margent* of the *Stile* hath; The *Middle Rail* hath commonly two breadths of the *Margent* of the *Stile*, viz. one breadth above the *Sur-base*, and the other below the *Sur-base*. And the *Upper* and *Lower Rails* have also each the same breadth with the *Margent* of the *Stile*.

Those Moldings above the Prickt line on the Top, as H, are called the *Cornice*.

Sometimes (and especially in Low Rooms) there is no *Base* or *Sur-base* used, and then the *Middle* and *Lower-Rail* need not be so broad: For the *Middle Rail* need not be above a third part more than the *Margent* of the *Rail*: and the *Lower-Rail* you may make of what breadth you see convenient: They are commonly about three Inches and an half, or four Inches broad, yet this is no Rule: For sometimes Workmen make only a flat Plinth serve.

You may (if you will) adorn the outer edges of the *Stiles* and *Rails* with a small *Molding*: And you may (if you will) Bevil away the outer edges of the *Pannels* and leave a Table in the middle of the Panel.

An Explanation of Terms used among Foyners.

When I first began to Print these Exercises, I marked some Terms in *Foyner*y with *superiour Letters* (as Printers call them) thus a b c &c. intending at the latter end of these Exercises to have explained the Terms those Letters referr'd to; But upon consideration that those Terms might often be used in this Discourse, when the Superiour Letter was out of sight, and perhaps its position (where) forgotten; I have changed my mind, and left out the Superiour Letters beyond fol. 66. and instead of those References give you this Alphabetical Table of Terms, by which you may always more readily find the Explanation though you often meet with the Term.

A.

Architrave. See Plate 6. *l.* is the *Architrave Molding.*

Augre § 24. Plate 4. fig. K.

B.

Base. See Plate 6. *h.* And Plate 7. B.

Bead. See Plate 6. *a.*

Bed-molding. See Plate 6. *d.*

Basil. The Basil is an angle the edge of a Tool is ground away to. See fol. 71.

Batten. Is a Scantling of stuff either two, three or four Inches Broad: and is seldom above an Inch thick: and the length unlimitted.

Beak. The end of the Hold-fast. See fol. 60, 61.

Bench-Screw. See Plate 4. A. g. and fol. 60.

Bevil. Any sloping angle that is not a square, is called a Bevil. See fol. 60, 85. § 19. and Plate 4. F.

Bitts. See § 22.

Bow-saw. Plate 4. O.

R

C

C

Capital. See Plate 6. g.

Cast. Stuff is said to Cast or warp when by its own droughth or moisture or the droughth or moisture of the Air or other accident it alters its flatness and straightness.

Clamp. When a Peece of Board is fitted with the Grain to the end of another peece of Board crosses the Grain the first Board is *Clamp't*. Thus the ends of Tables are commonly *Clamp't* to preserve them from warping.

Compass saw. See fol. 9. and Plate 4. fig. R.

Cornice. See Plate 6. g. and Plate 7. H.

Cross-grained stuff. Stuff is Cross-grained when a Bough or some branch shoots out on that part of the Trunk of the Tree; For the Bough or branch shooting forwards, the Grain of that branch shoots forwards also, and so runs a cross the Grain of the Trunk; and if they be well grown together, it will scarce be perceived in some stuff, but in working; yet in Deal Boards, those Boughs, or branches are Knots, and easily Perceiv'd, and if it grew up young with the Trunk, then instead of a Knot you will find a Curling in the Stuff when it is wrought.

Curling-stuff. If the Bough or Branch that shoots out of the Trunk of a Tree be large, and the stuff in that place sawn somewhat aslope; when that stuff comes under the Plain you will find a Turning about or Curling on that place upon the stuff; and in a straight progress of the Plain the Iron will cut *with*, and suddenly *a-cross* the Grain, and that more or less as the Bough grew in the youth of the Tree, or grew more or less upright, or else

else sloping to the Trunck, or was sawn so. Such Stuff therefore is called *Curling stuff*.

D.

Door-case. Is the Fram'd work about the Door.

Double-Screw. See fol. 60. Plate 4. fig. g. on the work bench A.

F.

Facia. See Plate 6. b.

Fence. See § 8. Use of the Plow, and Pl. 4. fig. B 6.

Fine set. The Irons of Plains are set Fine, or Rinck. They are set fine, when they stand so shallow below the sole of the Plain that in working they take off a thin shaving. See § 3.

Flat Frieze. See Plate 6. p.

Fore-Plain. See § 2. and Plate 4 B 1.

Former. See § 10. and Plate 4. C 1. C 3.

Frame. See fol. 59, 60.

Frame Saw. See § 28. and Plate 4. O.

Free stuff. See § 3.

Frieze. See Plate 6. p.

Frieze Pannel. See Plate 7. L.

Frieze Rail. See plate 7. F.

Frony stuff. See § 3. G.

Gage. See § 21. and Plate 4. G.

Gimblet. See § 23. and Plate 4 I.

Gouge. see § 14. C 6.

Groove. see fol. 69.

H.

Hammer-hard. See Numb. III. fol 58.

Handle. See § 15. and Plate 4. D a.

Hard stuff. See § 3.

Hatchet. See § 25. Plate 4 L.

Head. See § 22. Plate 4. H a.

Hold-fast. See § 1. Plate 4. A d.

Hook. See § 1 Plate 4. A b.

Husk. See Plate 6. n. R 2

I

Inner-square. See § 15. and Plate 4. D d.

Joynt. See fol 59.

Foynter. See § 4. and Plate 4. B 2.

Iron. See § 2. and Plate 4. B 1 d.

K.

Kerf. The Sawn-away slit between two peeces of stuff, is called a kerf: See fol 95.

Knob. See § 36. fol. 104. and Plate 5. fig. 7. N.

Knot. See Plate 6. o.

L.

Large Pannel. See Plate 7. K.

Lying Pannel. See Plate 7. I.

Lower Rail. See Plate 7. H.

M.

Margent. See Plate 7. at AAA the flat bredth of the Stiles besides the Moldings is called the Margent of the stiles.

Middle Rail. See Plate 7 E E.

Miter. See fol. 60.

Miter Box, See § 20. and Plate 5. fig. 1.

Miter square. See § 18. and Plate. 4. E.

Moldings. The severall wrought-work made with Plains on wood, is called *Moldings*. See Plate 6.

Molding Plains. See § 9.

Mortefs. Is a square hole cut in a peece of stuff, to entertain a Tennant fit to it. see § 17.

Mortefs Chissel. see § 13. and Plate 4. C 5.

Mouth. see § 2. B 7. a The Mouth.

O.

Ogee. See Plate 6. c.

Oval. See § 21. and Plate 4. G b.

Outer Square. See § 15. and Plate 4. D c.

P

Pad. See § 22 and Plate 4. H b

Pan-

Pannel. In Plate 7. I K L are Pannels, but distinguished by their positions.

Pare. The smooth cutting with the Paring Chisel is called *Paring*.

Paring Chisel. See § 11. and Plate 4. C 2.

Pilaster. See Plate 6. f.

Peircer, See § 22. and Plate 4. H.

Pit-man. The Sawyer that works in the Pit, is called the Pit-man,

Pit-Saw. The Pit-Saw is a great Saw fitted into a square Frame ; as in Plate 4. M is a Pit-Saw.

Planchier. In Pl. 6 between *d* and *e* is the Planchier.

Plinth. See Plate 6.

Plow. See § 8. and Plate 4. B 6.

Pricker. Is vulgarly called an Awl : yet for Joyners use it hath most commonly a square blade, which enters the Wood better than a round Blade will ; because the square angles in turning it about, breaks the Grain and so the Wood is in less danger of splitting.

R.

Rabbet. See § 7.

Rabbet Plain. See § 7. and Plate 4. B 5.

Rack See Plate 5. Fig. 8. Read § 36.

Rail. See Plate 7. AAA.

Ranck. The Iron of a Plain is said to be *set Ranck*, when its edge stands so far below the Sole of the Plain, that in working it will take off a thick shaving. See § 3.

• *Ranck-set,* See Ranck.

Range. The side of any work that runs straight, without breaking into angles, is said to *run Range* : Thus the Rails and Pannels of one straight side of Wainscoting is said to *run Range*.

Re-

Return. The side that falls away from the Fore-side of any Straight or Range-work, is called the *Return*.

Riglet. Is a flat thin square peece of Wood: Thus the peeces that are intended to make the Frames for small Pictures, &c. before they are Molded are called *Riglets*.

Rnb. See fol. 64.

S.

Sam-wrest. See § 16 fol. 94. and Plate 4 O.

Scamlin. The size that your Stuff is intended to be cut to.

Scribe. When Joyners are to fit a side of a peece of Stuff against the side of some other peece of Stuff, and the side of the peece of Stuff they are to fit to is not regular; To make these two peeces of Stuff joyn close together all the way, they Scribe it, (as they phrase it,) thus; They lay the peece of Stuff they intend to Scribe close against the other peece of Stuff they intend to Scribe to, and open their Compasses to the widest distance, these two peeces of Stuff bear off each other: Then (the Compasses moving stiff in their Joynt) they bear the point of one of the shanks against the side they intend to Scribe to, and with the point of the other shank they draw a line upon the Stuff to be Scribed; and then the points of the Compasses remaining unmov'd, and your hand carried evenly along by the side of the peece to be Scribed to, that line scribed upon the peece intended to be Scribed shall be parallel to the irregular side intended to be Scribed to: And if you work away your Stuff exactly to that line, when these two peeces are put together, they shall seem a Joynt.

Shoot a Joynt. See fol. 59.

Skew-

Skew-former. See § 12. and Plate 4. C 4.

Smoothing Plane. See § 6. and Plate 4. B 4.

Sole. See Plate 4. B 7. *b a b.* The under-side of a Plain is called the *Sole*.

Square. See § 15. and Plate 4. D.

Staff. See § 21. and Plate 4. G c.

Staves. See § 8. and Plate 4. B 6. *a a.*

Stile. The upright Peeces AA in Pl. 7. are *Stiles*.

Stock. See § 22. and Plate 4. H c.

Stops. In Plate 6 *kk* are *Stops*.

Stuff. The Wood that Joyners work upon they call in general *Stuff*.

Sur-base. In Plate 7. D is the *Sur-base*.

Swelling-Frieze. In Plate 6. *r* is the *Swelling-frieze*.

T.

Table. In Plate 6. *f* is the *Table*.

Taper. All sorts of Stuff or work that are smaller at one end than at the other, and diminish gradually from the biggest end, is said to be *Taper*.

Tennant. Is a square end fitted into a Mortise. See § 17.

Tennant Saw. In Plate 4. O would be a Tennant Saw, were the flat of the Blade turned where the edge there stands.

Tongue. See § 16. and Plate 4. D *b.*

Tooth. See § 21. and Plate 4. G *a.*

Top-man. Of the two Sawyers, the uppermost is called the *Top-man*.

Tote. See § 2. and Plate 4. B 1 *a.*

Traverse. See fol. 65.

Trussel. See fol. 97. and Plate 5. Fig. 3.

Try. See § 31.

V.

Vaws-Cornice. See Plate 6. *c.*

Upper Cornice. See Plate 6. *t.*

W.

W.

Warp. The same that Cast is.*Waving Engine.* See § 36. and Plate 5.*Wedge.* See § 2. and Plate 4. B 1. c.*Wheeling-Block.* See Plate 4. P.*Whip-Saw.* See Plate 4. N.*Wrest.* See § 26. and Plate 4. Q.

Thus much of Joynery. The next Exercises will
(God willing) be of Carpentry.

Advertisement.

THere is invented by the Right Honorable the Earl of Castlemain, a new kind of Globe, call'd (for distinction sake) the English Globe; being a fix'd and immovable one, performing what the Ordinary ones do, and much more, even without their usual Appendancies; as Wooden Horizons, Brazen Meridians, Vertical Circles, Horary Circles, &c. For it composes it self to the site and Position of the World, without the Mariners Compass; or the like foreign Help; and besides other useful and surprising Operations (relating both to the Sun and Moon, and performed by the Shade alone), we have by it not only the constant proportion of Perpendiculars to their Shades; with several Corollaries thence arising; but also an easie, new, and most compendious way of describing Dyals on all Planes, as well Geometrically, as Mechanically: most of which may be taught any one in few Hours, though never so unacquainted with Mathematicks.

To this is added on the Pedestal a Projection of all the appearing Constellations in this Horizon, with their Figures and Shapes. And besides, several new things in it differing from the common Astrolabe, (tending to a clearer and quicker way of Operating) the very Principles of all Steriographical Projections are laid down, and Mathematically demonstrated; as is every thing else of Moment throughout the whole Treatise.

These Globes will be made, and expos'd to Sale about August next, (God willing :) against which time the Book for its use will also be Printed, and sold by Joseph Moxon, on Ludgate-Hill, at the Sign of Atlas.

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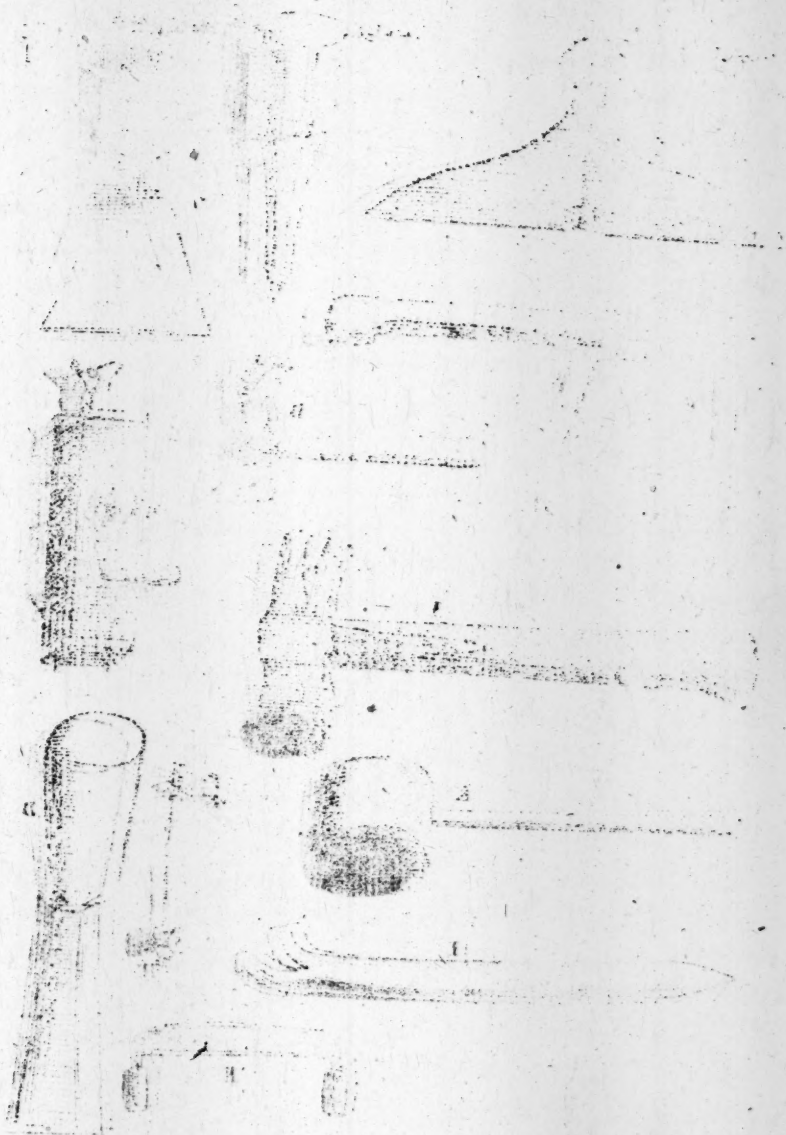


Plate 8.

Head of the Socket Chisel

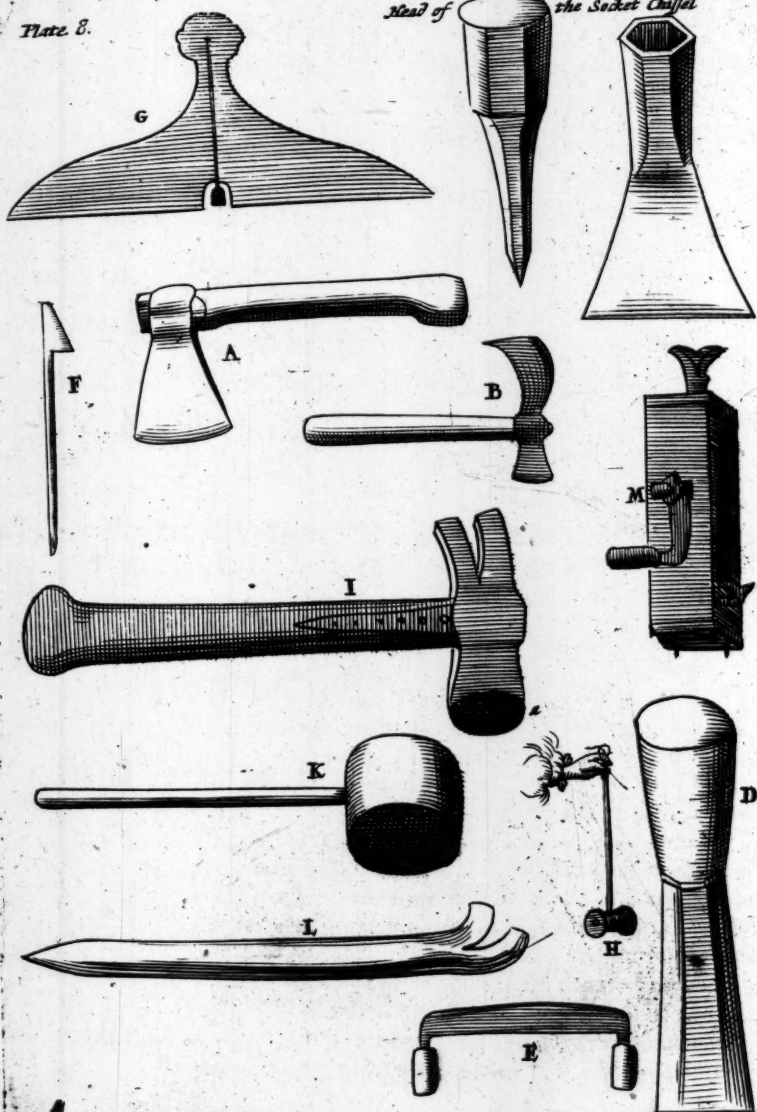
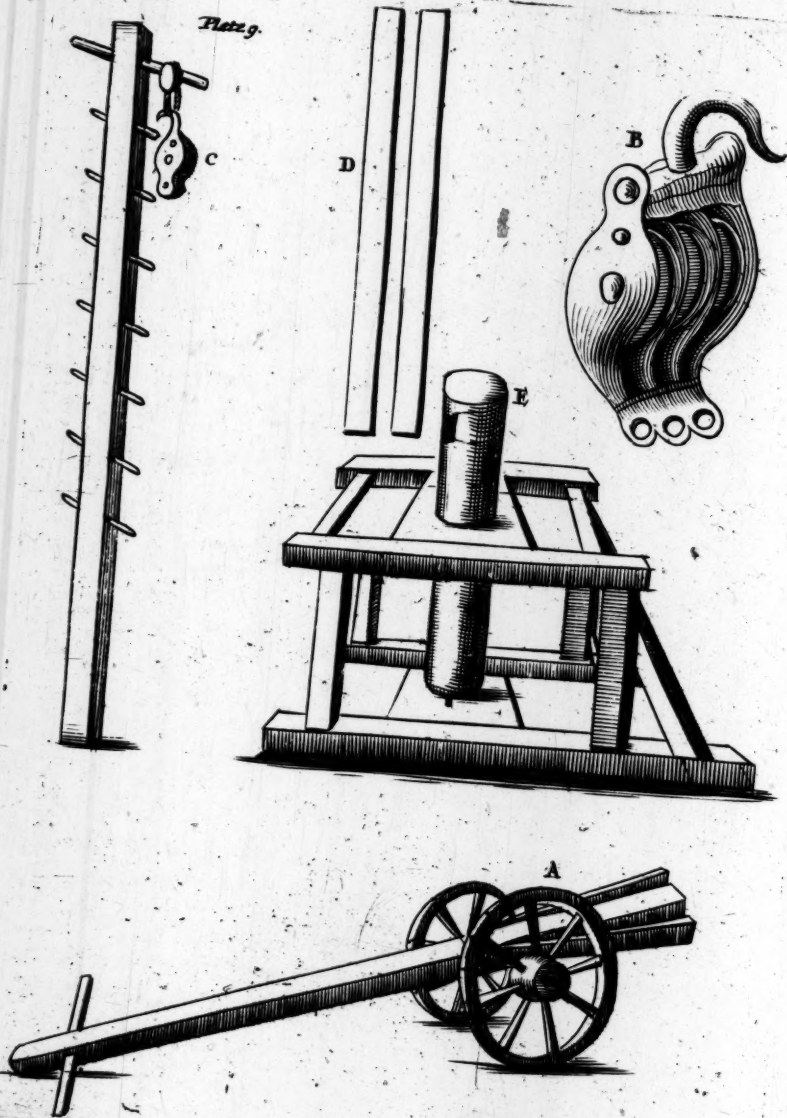


Plate g.



Numb. VII.

MECHANICK
EXERCISES.

O R,

The Doctrine of

Handy-works,

Applied to the Art of House-Carpentry.

By *Joseph Moxon*, a Member of
the Royal Society, and Hydrographer
to the King's most Excellent Majesty.



L O N D O N,

Printed for *Joseph Moxon*, at the Sign of *Atlas* on
Ludgate Hill. 1679.

MICHIGAN

EX

By 7000

the Royal

Printed for

MECHANICK EXERCISES,

O R,

The Doctrine of *Handy-works* : appli-
ed to the Art of *House-Carpentry*.

BEing now come to exercise upon the *Carpenters* Trade, it may be expected by some that I should insist upon *Architecture*, it being so absolutely necessary for Builders to be acquainted with: But my Answer to them is, that there are so many Books of *Architecture* extant, and in them the Rules so well, so copiously, and so completely handled, that it is needless for me to say any thing of that Science: Nor do I think any man that should, can do more than collect out of their Books, and perhaps deliver their meanings in his own words. Besides, *Architecture* is a Mathematical Science, and therefore different from my present undertakings, which are (as by my Title) Mechanick Exercises: yet because Books of *Architecture* are as necessary for a Builder to understand as the use of Tools; and lest some Builders should not know how to enquire for them, I shall at the later end of *Carpentry* give you the Names of some Authors, especially such as are printed in the English Tongue.

Some may perhaps also think it had been more proper for me in these Exercises to have introduced

S

Car-

Carpentry before *Joyner*y, because *Necessity* (the *Mother of Invention*) did doubtless compel our *Forefathers* in the beginning to use the *conveniency* of the first, rather than the *extravagancy* of the last. I confess, I considered it my self, and had in my own reason been persuaded to it, but that I also considered, that the *Rules* they both work by are upon the matter the same, in *Sawing*, *Mortessing*, *Tenancing*, *Scribbing*, *Paring*, *Plaining*, *Moulding*, &c. and likewise the *Tools* they work with the same, though some of them somewhat stronger for *Carpenters* use than they need be for *Joyners*; because *Joyners* work more curiously, and observe the *Rules* more exactly than *Carpenters* need do. And therefore I say it was, that I began with *Joyners* before *Carpentry*; for he that knows how to work curiously, may when he lists work slightly; whereas they that are taught to work more roughly, do with greater difficulty perform more curious and nice works. Thus we see *Joyners* work their *Tables* exactly flat and smooth, and shoot their *Joynts* so true, that the whole *Table* shews all one piece: But the *Floors* *Carpenters* lay, are also by the *Rule of Carpentry* to be laid flat and true, and shall yet be well enough laid, though not so exactly flat and smooth as a *Table*.

Yet though the *Rules* *Joyners* and *Carpenters* work by are so near the same, and the *Tools* they work with, and *Stuff* they work upon, the same; yet there are many *Requisites* proper to a *Carpenter*, (especially a *Master Carpenter*) that a *Joyner* need take little notice of, which after I have described the *Carpenters Tools* that are not express among the *Joyners*, I shall speak to.

London: Printed and sold by J. Sturges at the Sign of the Anchor in St. Dunstons Church-yard, 1682.

§ 1. *Of several Tools used in Carpentry, that are not used in Joynery. And first of The Ax.*

THe Ax marked *A* in *Plate 8.* is (as you see) different from what the Joyners Hatchet is, both in size and form; theirs being a light Hatchet, with a Basil edge on its left side, because it is to be used with one hand, and therefore hath a short Handle: But the Carpenters Ax being to hew great Stuff, is made much deeper and heavier, and its edge tapering into the middle of its Blade. It hath a long Handle, because it is used with both their hands, to square or bevel their Timbers.

When they use the Ax, the Timber hath commonly some Bark or Log laid under it near each end, that the edge of the Ax may be in less danger of striking into the ground, when they hew near the bottom of the Timber. And they commonly stand on that side the Timber they hew upon.

§ 2. *Of the Adz, and its use.*

THe Adz marked *B* in *Plate 8.* hath its Blade made thin, and somewhat arching. As the Ax hath its edge parallel to its Handle, so the Adz hath its edge athwart the Handle, and is ground to a Basil on its inside to its outer edge: wherefore when it is blunt they cannot well grind it, unless they take its Helve out of its Eye.

Its general use is to take thin Chips off Timber or Boards, and to take off those irregularities that the Ax by reason of its form cannot well come at; and that a Plain (though rank set) will not make riddance enough with.

It is most used for the taking off the irregularities on the framed work of a Floor, when it is framed and pind together, and laid on its place; for that lying flat under them, the edge of the *Ax* being parallel to its Handle (as afore said) cannot come at the irregularities to take them off; but the *Adz* having its edge athwart the Handle will. Again, upon some Posts framed upright, and range with other framed work close to it, the edge of the *Ax* cannot come at the irregularities (for the reason afore said) but the *Adz* will. And the like for the irregularities of framed work on a Ceiling, &c.

When they work upon the framed work of a Floor, they take the end of the Handle in both their hands, placing themselves directly before the irregularity, at a small distance, stradling a little with both their Legs, to prevent danger from the edge of the *Adz*, and so by degrees hew off the irregularity. But if they hew upon an Upright, they stand directly before it.

They sometimes use the *Adz* upon small thin Stuff, to make it thinner, (but this is many times when the *Ax* or some other properer Tool lies not at hand) and then they lay their Stuff upon the Floor, and hold one end of it down with the Ball of the Foot, if the Stuff be long enough; if not, with the ends of their Toes, and so hew it lightly away to their size or form, or both.

§ 3. Of Carpenters Chissels in general.

THough Carpenters for their finer work use all the sorts of *Chissels* described in *Exercise 4.* yet are not those sorts of *Chissels* strong enough for their rougher and more common work, and therefore they also use a stronger sort of *Chissels*; and distinguish them by the name of *Socket Chissels*: For whereas those *Chissels* Joyners use have their wooden heads made hollow to receive the Iron Sprig above the Shoulder of the Shank, Carpenters have their Shank made with an *hollow Socket* at its top, to receive a strong wooden Sprig made to fit into that Socket, with a square Shoulder above it, the thickness of the Iron of the Socket, or somewhat more; which makes it much more strong, and able to endure the heavy blows of the *Mallet* they lay upon the head of the *Chisset*. And the Shanks and Blades are made stronger for Carpenters use than they are for Joyners.

Of these *Socket Chissels* they have of the several sorts described in Joynerie, though not all severally distinguished by their names; for they call them *Half Inch*, *Three quarter Inch Chissels*, *Inch and half*, *Two Inch* to *Three Inch Chissels*, according to the breadth of the Blade. But their uses are the same mentioned in Joynerie, though the manner of using them besomewhat different too: For as I told you in Joynerie, the Joyners press the edge of the Blade into the Stuff with the strength of their Shoulders, but the Carpenters with the force of the blows of the *Mallet*. And the Joyners guide their *Chissels* differently from what the Carpenters do their *Socket Chissels*; for the Joyners hold the Shank and Blade of their *Chissels* as

I described in *Numb. 4. Sect. 11.* but the Carpenters hold the Shank of their *Chissels* in their clutched left hand, and beat upon the Head with the *Mallet* in the right. See the Figure of the *Socket Chissel* in *Plate 8. C.* with its Head *a* out of the Socket.

s 4. *Of the Ripping Chissel, and its use.*

THe *Ripping Chissel* described *Plate 8. D.* is a *Socket Chissel*, and is about an Inch broad, and hath a blunt edge. Its edge hath not a *Basil* as almost all other *Chissels* have, and therefore would more properly be called a *Wedge* than a *Chissel*. But most commonly Carpenters use an old cast off *Chissel* for a *Ripping Chissel*.

Its office is not to cut wood as others do, but to *rip* or *tear* two pieces of wood fastned together from one another, by entering the blunt edge of it between the two pieces, and then knocking hard with the *Mallet* upon the head of the Handle, till you drive the thicker part of it between the two pieces, and so force the power that holds them together (be it Nails or otherwise) to let go their hold: For its blunt edge should be made of Steel and well tempered, so that if you knock with strong blows of the *Mallet* the *Chissels* edge upon a Nail (though of some considerable substance) it may cut or break it short asunder. If you cannot at once placing the *Ripping Chissel* part the two pieces, you must use two *Ripping Chissels*, placing the second at the remotest entrance in the breach, and driving that home will both open the breach wider, and loosen the first *Ripping Chissel*, so that you may take it out again, and place it further in the breach: And so you must con-

continue edging further and further, till you have separated your intended pieces.

It is sometimes used when Carpenters have committed error in their work, and must undo what they did, to mend it. But it is generally used in all alterations and old work.

§ 5. *Of the Draw-knife, and its use.*

THe *Draw-knife* described *Plate 8. E.* is seldom used about House-building, but for the making of some sorts of Household-stuff; as the Legs of Crickets, the Rounds of Ladders, the Rails to lay Cheese or Bacon on, &c.

When they use it, they set one end of their work against their Breast, and the other end against their Work-bench; or some hollow angle that may keep it from slipping, and so pressing the work a little hard with their Breast against the Bench, to keep it steady in its position, they with the Handles of the *Draw-knife* in both their hands, enter the edge of the *Draw-knife* into the work, and draw Chips almost the length of their work, and so smoothen it quickly.

§ 6. *Of Hook-Pins, and their use.*

THe *Hook-Pin* is described *Plate 8. F.* *a* the *Pin*, *b* the *Hook*, *c* the *Head*. Its office is to pin the Frame of a Floor or Frame of a Roof together, while it is framing, or while it is sitting into its position. They have many of these *Hook-Pins* to drive into the several angles of the Frame. These they drive into the Pin-holes through the Mortises and Tenants, and being made taper, do with a Hammer striking on the

the bottom of it knock it out again; or they most commonly strike under the Hook, and so knock it out. Then if the Frame lie in its place, they pin it up with wooden Pins.

§ 7. *Of the Level, and its use.*

THe *Level* described *Plate 8. G.* *a a* the *Level*, *b* the *Plumbet*, *c* the *Plumb-line*, *d d* the *Perpendicular* mark'd from the top to the bottom of the Board. The *Level* is from two to ten foot long, that it may reach over a considerable length of the work. If the *Plumb-line* hang just upon the *Perpendicular. d d*, when the *Level* is set flat down upon the work, the work is *Level*: But if it hang on either side the *Perpendicular*, the Floor or work must be raised on that side, till the *Plumb-line* hang exactly upon the *Perpendicular*.

§ 8. *Of the Plumb-line, and its use.*

THe *Plumb-line* is described *Plate 8. H.* *a* the *Line Rowl*, *b* the *Line*. It is used to try the upright standing of Posts, or other work that is to stand perpendicular to the Ground Plot; and then they draw off so much Line as is necessary, and fasten the rest of the Line there, upon the *Line Rowl* with a Slip-knot, that no more Line turn off. They hold the end of the Line between their Finger and Thumb half the Diameter of the *Line Rowl* off one corner of the Post or work, and if the *Line* and Corner of the Post be parallel to each other, the Post is upright: But if the Post be not parallel to the *Line*, but its bottom stands more than half the Diameter of the *Line Rowl* from

from the *Line*, the Post hangs so much over the bottom of the Post on that side the *Line* bears off, and must be forced backward still the side of the Post and the *Line* become parallel to each other. But if the bottom of the corner of the Post stand out from the top of the *Line*, the Post must be forced forwards to comply with the *Line*.

§ 9. Of the Hammer, and its use.

THe Hammer is described Plate 8. I. *a* the Face, *b* the Claw, *c c* the Pen at the return sides of the Claw. This Tool was forgot to be described in *Joyner*y, though they use *Hammers* too, and therefore I bring it in here. Its chief use is for driving Nails into work, and drawing Nails out of work.

There is required a pretty skill in driving a Nail; for if (when you set the point of a Nail) you be not curious in observing to strike the flat face of the Hammer perpendicularly down upon the Perpendicular of the Shank, the Nail (unless it have good entrance) will start aside, or bow, or break; and then you will be forced to draw it out again with the Claw of the Hammer. Therefore you may see a reason when you buy a Hammer, to chuse one with a true flat Face.

A little trick is sometimes used among some (that would be thought cunning Carpenters) privately to touch the head of the Nail with a little Ear-wax, and then lay a wager with a stranger to the Trick, that he shall not drive that Nail up to the Head with so many blows. The stranger thinks he shall assuredly win, but does assuredly lose; for the Hammer no sooner touches the Head of the Nail, but instead of entering

T

the

the wood it flies away, notwithstanding his utmost care in striking it downright.

§ 10. Of the Commander, and its use.

THe *Commander* is described *Plate 8. K.* It is indeed but a very great wooden *Mallet*, with an Handle about three foot long, to use in both the hands.

It is used to knock on the Corners of Framed work, to set them into their position. It is also used to drive small wooden Piles into the ground, &c. or where greater Engines may be spared.

§ 11. Of the Crow, and its use.

THe *Crow* is described in *Plate 8. L.* *a* the *Shank*, *b b* the *Claws*, *c* the *Pike-end*. It is used as a *Lever* to lift up the ends of great heavy Timber, when either a *Bauk* or a *Rowler* is to be laid under it; and then they thrust the *Claws* between the Ground and the Timber, and laying a *Bauk* or some such stuff behind the *Crow*, they draw the other end of the *Shank* backwards, and so raise the Timber.

§ 12. Of the Drug, and its use.

THe *Drug* described *Plate 9. A.* is made somewhat like a low narrow *Carr*. It is used for the carriage of Timber, and then is drawn by the Handle *a a*, by two or more men, according as the weight of the Timber may require.

There are also some Engines used in Carpentery, for the management of their heavy Timber, and hard

Labour, viz. the *Jack*, the *Crab*, to which belongs Pulleys and Tackles, &c. *Wedges*, *Rowlers*, *great Screws*, &c. But I shall give you an account of them when I come to the explanation of Terms at the later end of *Carpentry*.

§ 13. *Of the Ten-foot Rod, and thereby to measure and describe the Ground-plot.*

WE shall begin therefore to measure the *Ground-plot*, to which Carpenters use a *Ten-foot Rod* for expedition, which is a Rod about an Inch square, and ten foot long; being divided into ten equal parts, each part containing one foot, even as the *Two-foot Rule* described in Exercise 6. § 31. is divided into 24 equal parts, and their Sub-divisions.

With this Rod they measure the length and breadth of the *Ground-plot* into Feet, and if there be odd Inches, they measure them with the *Two-foot Rule*. Their measure they note down upon a piece of paper, and having considered the situation of the Sides, *East*, *West*, *North*, and *South*, they draw on Paper their several Sides accordingly, by a small Scale, either elected or else made for that purpose. They may elect their *Two-foot Rule* for some Plots; for an Inch and an half may commodiously serve to set off one Foot on some small *Ground-plots*, and then you have the Inches to that Foot actually divided by the marks for the half quarters on the *Two-foot Rule*. But this large Scale will scarce serve to describe a *Ground-plot* above ten Foot in length, because a small sheet of Paper is not above 15 or 16 Inches long, and therefore one sheet of Paper will not contain it if the *Ground-plot* be longer: Therefore if you make every half quarter of an

Inch to be a Scale for two Inches, a Sheet of Paper will contain 20 Foot in length: And if you make every half quarter of an Inch to be a Scale for four Inches, a Sheet of Paper will contain 40 Foot. And thus by diminishing the Scale, the sheet of Paper will contain a greater number of Feet.

But having either elected, or else made your Scale, you are to open your Compasses to the number of Feet on your Scale your *Ground-plot* hath in length, and then transfer that distance to your Paper, and to draw a streight Line between the two Points, and mark that streight Line with *East*, *West*, *North*, or *South*, according to the situation of that side of the *Ground-plot* it represents. Then again open your Compasses to the number of Feet on your Scale one of the adjoining sides contains, and transfer that distance also to your Paper, and draw a Line between the two points, and note its situation of *East*, *West*, *North*, or *South*, as before. Do the like by the other sides; and if either a Quirk or any Addition be added to the Building, on any side of your *Ground-plot*, you must describe it also proportionably.

Then you are to consider what Apartments or Partitions to make on your *Ground-plot*, or second or third Story, and to set them off from your Scale, beginning at your intended Front. As for example; suppose your *Ground-plot* be a Long-square, 50 Foot in length, and 20 Foot wide: This *Ground-plot* will contain in its length two good Rooms, and a Yard behind it 10 Foot long. If you will, you may divide the 40 Foot into two equal parts, so will each Room be 20 Foot square: Or you may make the Rooms next the Front deeper or shallower, and leave the remainder for the Back Room: As here the Front
Room

Room is 25 Foot, and the Back Room 15 Foot deep, and a setting off of 8 Foot broad and 10 Foot long taken out of the Yard, for a Buttery below stairs (if you will) and Closets above stairs over it. But what width and depth soever you intend your Rooms shall have, you must open your Compasses to that number of Feet on your Scale, and set off that Distance on the *East, West, North, or South* Line, according to the Situation of that side it represents on your *Ground-plot*. If you set it off the *East* Line, you must also set it off on the *West*; if on the *North* Line, you must also set it off on the *South* Line: Because between the two Settings off on the *East* and *West* Lines, or *North* or *South* Lines, you must draw a straight Line of the length of your intended Partition. And in this manner you must from every Partition draw a Line in its proper place on the Paper, by measuring the Distances each Partition must have from the outside of the *Ground-plot*.

And thus you are also to describe by your Scale your Front, and several sides of the Carcase; allowing the *Principal Posts, Posts, Enterduces, Quarterings, Braces, Gables, Doors, Windows, and Ornaments*, their several sizes, and true positions by the Scale: Each side upon a Paper by it self: Unless we shall suppose our Master Workman to understand *Perspective*; for then he may on a single piece of Paper describe the whole Building, as it shall appear to the Eye at any assigned station.

§ 14. Of Foundations.

HAVING drawn the *Draft*, the Master Workman is first to cause the Cellars to be dug, if the House shall have Cellars: And then to try the Ground, that it be all over of an equal firmness, that when the weight

of

of the Building is set upon it, it may not sink in any part. But if the Ground be hollow or weaker in any place, he strengthens it, sometimes by well ramming it down, and levelling it again with good dry Earth, Lime-Core, Rubbish, &c. or sometimes with ramming in Stones, or sometimes with well Planking it; or most securely by driving in Piles. But driving in of Piles is seldom used for Timber Houses, but for Stone or Brick Houses, and that but in few places of *England* neither, but where the Ground proves *fenny* or *moorish*. Therefore a further account shall be given of Foundations, when I come to exercise upon *Masonry*, &c.

Then are the Cellar Walls to be brought up by a *Bricklayer* with *Brick*; for small Houses two Bricks thick, for bigger two and an half Bricks thick, or three or four Bricks thick, according to the bigness of the House, and quality of the Ground, as I shall shew when I come to Exercise on *Bricklaying*.

But if the House be designed to have no Cellars (as many Countrey Houses have not) yet for the better securing the Foundation, and preserving the Timber from rotting, Master Workmen will cause three or four or five course of Bricks to be laid, to lay their *Ground-plates* upon that Foundation.

The Foundation being made good, the Master-workman appoints his under-workmen their several *Scautlins*, for *Ground-plates*, *Principal Posts*, *Posts*, *Bressummers*, *Girders*, *Trimmers*, *Joists*, &c. which they cut square, and frame their Timbers to, as has been taught in the several Exercises upon *Joinery*, (whither I refer you) and there set them up, each in his proper place, according to the Draft.

The

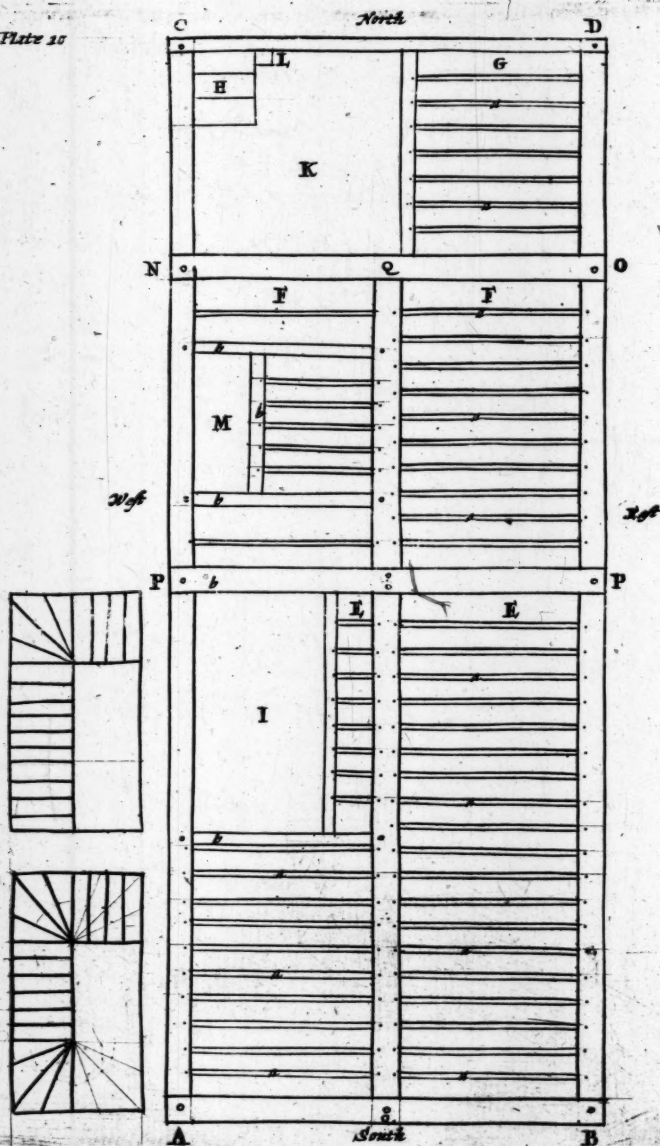
The Draft of a Foundation I have described in Plate 10, according to a Scale of eight Foot in an Inch; where you have the Front A B 20 Foot long, the sides A C and B D 30 Foot long. The Shop or first Room E E 23 Foot (as aforesaid) deep. I make the first Room a Shop, because I intend to describe Shop-windows, Stalls, &c. though you may Build according to any other purpose: the *Kitching* or *Back Room* F F 15 Foot deep. A *Buttery* or *Closet* taken out of the *Yard*, marked G, 10 foot deep, and 8 foot wide. H a *Setting off* in the *Yard*, 4 foot square for the *House of Office*. I *Leaving way* in the Shop for a *Stair Case* 6 foot, and 11 foot. K the *Yard*. L the *Sink-hole* 1 foot square. M *Leaving way* in the *Kitching* 6 foot deep, and 4 foot wide for the *Chimneys*.

I do not deliver this Draft of Partitions for the most commodious for this Ground-plot, nor is the House set out designed for any particular Inhabitant; which is one main purpose to be considered of the Master-Workman, before he make his Draft; for a Gentlemans house must not be divided as a Shop-keepers, nor all Shop-keepers Houses alike; for some Trades require a deeper, others may dispense with a shallower Shop, and so an inconvenience may arise in both. For if the Shop be shallow, the Front Rooms upwards ought to be shallow also: because by the strict Rules of *Architecture*, all Partitions of Rooms ought to stand directly over one another: for if your Shop stand in an eminent Street, the Front Rooms are commonly more Airy than the Back Rooms; and always more commodious for observing publick Passages in the Street, and in that respect it will be inconvenient to make the Front Rooms shallow: But if you have a fair Prospect
back-

backwards of Gardens, Fields, &c. (which seldome happens in Cities) then it may be convenient to make your Back Rooms the larger for Entertainment, &c. But I shall run no further into this Argument: for I shall leave the Master workman to consult Books of *Architecture*, and more particularly the Builder, which in this case they all ought to do.

ME-

Plate 10



Numb. VIII.

MECHANICK
EXERCISES.

O R,

The Doctrine of

Handy-works.

Applied to the Art of House-Carpentry.

By *Joseph Moxon*, a Member of
the Royal Society, and Hydrographer
to the King's most Excellent Majesty.



L O N D O N,

Printed for *Joseph Moxon*, at the Sign of *Atlas* on
Ludgate Hill. 1679.

MECHANICAL
EXTRACT

Edmond - 1800

Applied to the

By Joseph W. M.
the Royal Society
of London

LONDON

Printed for Joseph W. M.
and sold by the Author

MECHANICK EXERCISES,

O R,

The Doctrine of *Handy-works* : appli-
ed to the Art of *House-Carpentry*.

A C, B D, C D, N O, *Ground-plates, Wall-plates, Bressummers, Lintels, the Thickness of the Wall.*

A B, *Also a Ground-plate, or Ground-sell.*

P P, *The Summer.*

Q Q Q, *Girders.*

I, *The Well-houle for the Stairs, and Stair-case.*

M, *Leaving a way for the Chimnies.*

bb, *Trimmers for the Chimny way and Stair-case.*

a a a, *Joysts.*

s 15. *Of Framing for the Floors.*

THe four Plates, A B, A N, N O and B O, lying on the Foundation, are called *Ground-plates*. They are to be of good Oak, and for this size of Building about 8 Inches broad, and 6 Inches deep. They are to be framed into one another with Tennants and Mortesses. The longer Ground-plates A N and B O are commonly tennanted into the Front and Rear Ground-plates A B and N O, and into these two side-Ground-plates are Mortesses made for the Tennants at the ends of the Joysts, to be fitted somewhat loosely in, at about 10 Inches distance from one another, as in the Draft. These Ground plates are to be bor'd with

an Inch and half *Augur*, and well pinned into one another with round Oaken Pins, made tapering towards the point, and so strong, that with the hard blows of a Mallet, they may drive stiff into the *Augre hole*, and keep the Tennant firmly in the Mortels. The manner of making a Tennant and Mortels is taught in *Exercise 5. § 17.* But because the Stuff *Carpenters* work upon, is generally heavy Timber, and consequently not so easily mannaged as the light Stuff *Joyners* work upon, therefore they do not at first pin their Tennants into their Mortelses with wooden Pins, lest they should lie out of square, or any other intended Position: but laying a *Block* or some other piece of Timber under the corner of the Framework to bear it hollow off the Foundation, or what ever else it lies upon, they drive *Hook Pins* (described *Plate 8, § 6.*) into the four *Augre-holes* in the corners of the Ground-plates, and one by one fit the Plates either to a square, or any other intended Position: and when it is so fitted, they draw out their *Hook Pins*, and drive in the Wooden Pins (as aforesaid) and taking away the wooden *Blocks* one by one from under the corners of the Frame, they let it fall into its place.

But before they pin up the Frame of Ground-plates, they must fit in the *Summer* marked PP, and the *Girders* QQ and all the *Joists* marked a a a a &c. and the *Trimmers* for the *Stair-case*, and *Chilmney way* marked bb, and the binding *Joists* marked cc, for else you cannot get their Tennants into their respective Mortels holes. But they do I say fit all these in while the frame of Ground-plates lies loose, and may corner by corner be opened to let the respective Tennants into their respective Mortelses, which when
all

all is done, they frame the *Raising-plates* just as the *Ground-plates* are framed; and then frame the Roof into the *Raising-plates* with *Beams*, *Joists*, &c.

The *Summer* is in this *Ground-plate* placed at 25 foot distance from the Front, and is to be of the same scantlin the principal Plates are of, for Reasons as shall be shewn hereafter: and the *Girders* are also to be of the same Scantlins the *Summer* and *Ground-Plates* are of, though according to the nice Rules of *Architecture*, the *Back-Girder* need not be so strong as the *Front-Girder*, because it Bears but at 14 foot length, and the *Front-Girder* Bears at 24 foot length: yet Carpenters (for uniformity) generally make them so, unless they build an House by the great, and are agreed for the Sum of Money, &c.

The *Joists* Bearing at 8 Foot (as here they do) are to be 7 Inches deep, and 3 Inches Broad.

The *Trimmers* and *Trimming Joists* are 5 Inches broad and 7 Inches deep, and these *Joists*, *Trimmers* and *Trimming Joists*, are all to be pinned into their respected Mortises; and then its flatness try'd with the *Level*, as was taught § 7.

§ 16 Of setting up the Carcass.

Though the *Ground-plates*, *Girders*, &c. be part of the *Carcass*, yet I thought fit in the last Section they should be laid, before I treated of the superstructure, which I shall now handle. The four *Corner Posts* called the *Principal Posts* marked A A, should be each of one piece, so long as to reach up to the *Beam* of the *Roof*, or *Raising-Plate*, and of the same Scantlin the *Ground Plates* are of, viz. 8 Inches broad, and 6 Inches thick, and set with one of its

narrowest sides towards the Front. Its lower end is to be Tennanted, and let it into a Mortef made near the corner of the *Ground Plate* Frame; and its upper end hath also a Tennant on it, to fit into a Mortef made in the Beam of the Roof or *Raising piece*.

At the heighth of the first story in this Principal Post, must be made two Mortefes, one to receive the Tennant at the end of the Bressummer that lies in the Front, and the other to entertain the Tennant at the end of the Bressummer that lies in the Return side.

Two such Mortefes must also be made in this Principal Post at the heighth of the second Story, to receive the Tennants at the ends of the Bressummers for that Story.

Though I have spoken singularly of one *Principal Post*, yet as you work this, you must work all four *Principal Posts*; and then set them plumb upright, which you must try with a Plumb-line described in *Plate 8* s.

Having erected the *Principal Posts* upright, you must enter the Tennants of the Bressummers into their proper Mortefes, and with a Nail or two (about a single Ten or a double Ten) tack one end of a deal Boad, or some other light piece of stuff to the Bressummer, and the other end to the fram'd work of the Floor, to keep the *Principal Posts* upright, and in their places. Then set up the several Posts between the *Principal Posts*; but these Posts must be Tenanted at each end, because they are to be no longer than to reach from Story to Story, or from Entertise to Entertise, and are to be framed into the upper and under Bressummer. If the Entertises be not long enough, they set up a Principal Post between

tween two or three lengths, to reach from the Ground plate up to the Raising plates.

It is to be remembred, that the Bressummers and Girders are laid flat upon one of their broadest sides, with their two narrowest sides perpendicular to the Ground-Plot; but the Joysts are to be laid contrary: for they are framed so as to lie with one of their narrowest sides upwards, with their two broadest sides perpendicular to the Ground-Plot. The reason is, because the Stuff of the Bressummers and Girders are less weakned by cutting the Mortesses in them in this position, than in the other position; for as the Tennants for those Mortesses are cut between the top and bottom sides, and the flat of the Tennants are no broader than the flat of the narrowest side of the Joysts; so the Mortesses they are to fit into, need be no broader than the breadth of the Tennant, and the Tennants are not to be above an inch thick, and consequently the Mortesses are to be made with an Inch Mortels-Chissel, as was shewn Numb. 5. § 17. for great care must be taken that the Bressummers and Girders be not weakned more than needs, least the whole Floor dance.

These Tennants are cut through the two narrowest sides, rather than between the two broadest sides, because the stuff of the Girders retains more strength when least of the Grain of the stuff is cut: And the Tennants being made between the narrowest sides of the Joyces, require their Mortels-holes no longer than the breadth of that Tennant: And that Tennant being but an Inch thick, requires its Mortels but an Inch wide to receive it; so that you Mortels into the Girder no more than three Inches wide with the Grain of the Stuff, and one Inch broad contrary

to the Grain of the Stuff. But should the Tennant be cut between the two broad sides of the Joysts, the Mortefs would be three Inches long, and but one Inch broad, and consequently, you must cut into the Girder three Inches cross the Grain of the Stuff, which would weaken it more than cutting six Inches with the Grain and one Inch cross.

But it may be objected that the Tennants of the Joysts being so small, and bearing at an Inch thickness must needs be too weak.

Answer, first, though the Tennants be indeed but an inch thick, and three Inches broad; yet the whole Bearing of the Joyces do not solely depend upon their Tennants; because the Girders they are framed into, prove commonly somewhat Wainny upon their upper sides, and the Joysts are always scribed to project over that Waynniness, and so strengthen their Bearing by so much as they project over the roundness or waynniness of the upper side of the Girder.

Secondly, the Floor is boarded with the length of the Boards athwart the Joysts, and these Board firmly railed down to the Joysts, which also adds great strength to them.

Thirdly, The Joysts are seldom made to Bear at above ten foot in length, and should by the Rule of good workmanship not lie above ten Inches asunder at the most: so that this short Bearing and close discharging of one another, renders the whole floor firm enough for all common occupation. But if the Joyces do bear at above ten foot in length, it ought to be the care of the Master Workman to provide stronger stuff for them, *viz.* Thicker and Broader. If not, they cut a Tusk on the upper side of the Tennant, and let that Tusk into the upper side of the Girders.

Ha-

Having erected the Principal Post, and other Posts, and fitted in the Bressummers, Girders, Joysts, &c. upon the first Floor, they pin up all the Frame of Carcass-work. But though the Girders and Joysts described for this first floor, lie proper enough for it; yet for the second story, and in this particular case, the Joysts lie not proper for the second story; because in the second story we have described a *Balcony*.

Therefore in this case you must frame the Front-Bressumer about seven Inches lower into the Principal Posts: Because the Joysts for the second Floor are not to be Mortised into the Bressummer to lie even at the top with it, but must lie upon the Bressummer, and project over it so far as you design the *Balcony* to project beyond the Upright of the Front: And thus laying the Joysts upon the Bressummer renders them much stronger to bear the *Balcony*, than if Joysts were Tennanted into the Front of the Bressummer, and so project out into the Street from it.

But the truth is, Though I have given you a Draft of the Joysts lying athwart the Front and Rear for the first Floor, you may as well lay them Range with the two sides on the first Floor. But then the Bressummer that reaches from Front to Rear in the middle of the Floor must be stronger: And Girders must then be Tennanted into the Bressummer, and the Ground-plates at such a distance, that the Joysts may not Bear at above ten Foot in length. And the Tennants of the Joysts must be tennanted into the Girders, so that they will then lye Range with the two Sides.

But, a word more of the Bressummer: I say (as before) the Bressummer to Bear at so great length must
be

be stronger, though it should be discharged at the length of the Shop, (*viz.* at 25 Foot) with a Brick Wall, or a Foundation brought up of Brick. But if it shall have no Discharge of Brick-work, but Bear at the whole 40 Foot in length, your Bressummer must be yet considerably stronger than it need be, were it to Bear but 25 Foot in length; because the shorter all the Bearings of Timbers are, the firmer they Bear. But then the Framing work will take up more labour: And in many cases it is cheaper to put in stronger stuff for long Bearings, than to put a Girder between to Discharge the length of the Joysts to be framed into the Girders.

But to make short of this Argument, I shall give you the Scheme of Scantlins of Timbers at several Bearings for *Summers, Girders, Joysts, Rafter, &c.* as they are set down in the Act of Parliament for the rebuilding the City of *London*, after the late dreadful Fire: which Scantlins were well consulted by able Workmen before they were reduced into an Act.

Scantlings of Timber for the first sort of Houses.

	Foot	Inches	Inches	
For the Floor	Summers under—15—12—and—8			
	Wall-plates—7—and—5			
For the Roof	Foot { at foot—8 } 6 Inches			
	{ Principal Rafter under—15 { at top—5 } 6 Inches			
	{ Single Rafter—4—and—3 Inches			
	Length	Foot	Thickness	Depth
Joysts to	10	3	and	7 Inches
Garret floors	3			6

Scant-

Scantlings of Timber for the other two sorts of Houses.

	Foot		Breadth	Depth	Thickness	Depth
	Foot	Foot	Inches	Inches	Inches	Inches
Summers or Girders which bear in length from	10—	to 15—	11—	and 8—	Joyfts	3—6
	15—	18—	13—	9—	which	3—7
	18—	21—	14—	10—	bear	3—7
	21—	24—	16—	12—	10—	3—8
	24—	26—	17—	14—	foot	3—8
Principal Discharges upon Peers in the first Story in the Fronts			Inches	Inches		
			13	and 12		
Binding Joyfts with their Trimming Joyfts			15—	13		
					Thickness	Inches
Wall-plates, or Raifing Pieces and Beams					5—	depth equal to their own floors
Lintels of Oak in the			Inches	Inches		
			10	and 6		
Principal Rafter from			8—	6		
			7—	5		
Purlins from			5—	4		
Single Rafter			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Principal Rafter from			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		
Purlins from			1ft. and 2d. Story—	8 and 6		
			3d. Story—	5—4		
Single Rafter			Inches	Inches		
			10	and 6		
Purlins from			8—	6		
			7—	5		
Single Rafter			5—	4		

Scantlings for Sawed Timber and Laths, usually brought out of the West Countrey, not less than

	Breadth		Thickness	
	Foot	Inches	Inches	
Single Quarters in length	8	3 $\frac{1}{2}$	1 $\frac{3}{4}$	
Double Quarters in length	8	4	3 $\frac{1}{2}$	
Sawed Joysts in length	8	6	4	
Laths in length	$\left\{ \begin{array}{l} 5 \\ 4 \end{array} \right.$ 1 $\frac{1}{4}$ --- 1 quarter and $\frac{1}{2}$ Inch			

		Inches	
Stone Where Stone is used, to keep to these Scant- lings	First fort of Houses	Corner Peers	18 square
		Middle or single Peers	14 and 12
		Double Peers between House and House	14 and 18
		Door-Jambs and Heads	12 and 8

		Foot	Inches
2d & 3d forts	Corner Peers	2	6 square
	Middle or single Peers		18 square
	Double Peers between House and House		24 and 18
	Door-Jambs and Heads		14 and 10

Foot	Thickness
Scantlings for Sewers	$\left\{ \begin{array}{l} 3 \text{ wide} \\ 5 \text{ high} \end{array} \right.$ Side-walls—1 Brick $\frac{1}{2}$ Arch—1 Brick on end
	Bottom paved plain, and then 1 Brick on edge circular.

General Rules.

IN every Foundation within the Ground adde one Brick in thickness to the thickness of the Wall (as in the Scheme) next above the Foundation, to be set off in three Courses equally on both sides.

That no Timber be laid within twelve Inches of the fore-side of the Chimney Jambs : And that all Joysts on the back of any Chimney be laid with a Trimmer at six Inches distance from the Back.

That

That no Timber be laid within the Tunnel of any Chimney, upon penalty to the Workman for every default Ten Shillings, and Ten Shillings every week it continues unreformed.

That no Joysfs or Rafter's be laid at greater distances from one to the other, than twelve Inches; and no Quarters at greater distance than fourteen Inches.

That no Joysfs bear at longer length than Ten Foot; and no single Rafter's at more in length than Nine Foot.

That all Roofs, Window-frames, and Cellar-floors be made of Oak.

The Tile-pins of Oak.

No Summers or Girders to lie over the Head of Doors and Windows.

No Summer or Girders to lie less than Ten Inches into the Wall, no Joysfs than Eight Inches, and to be laid in Lome.

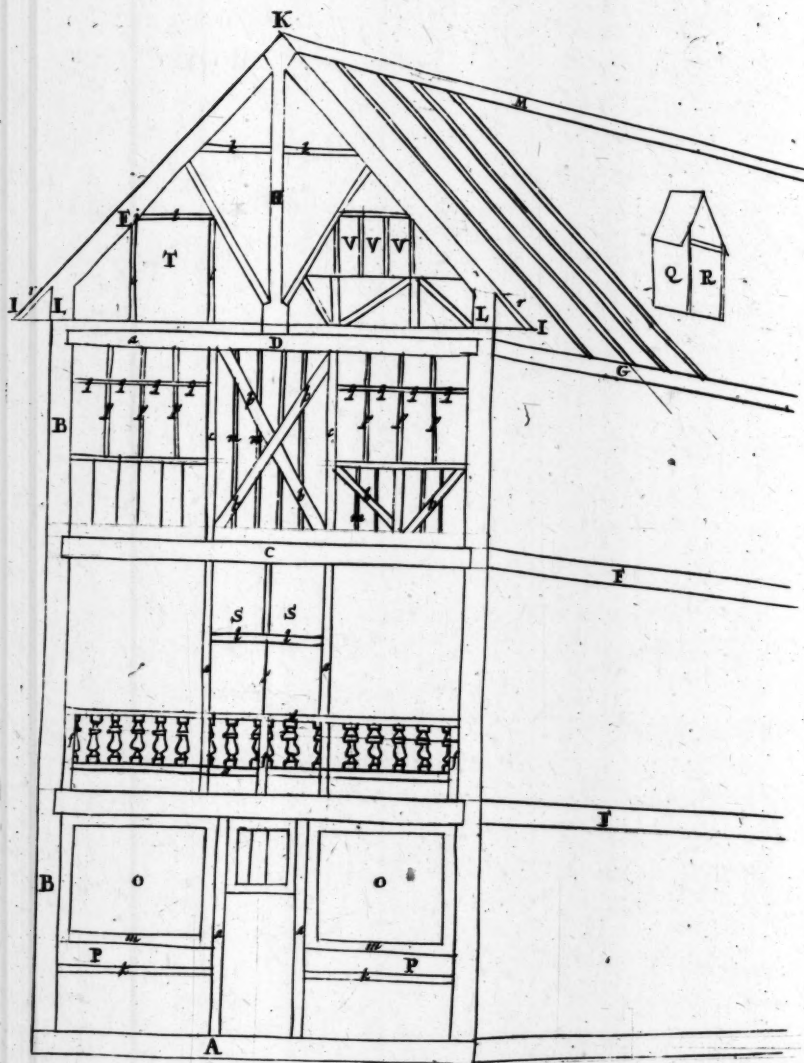
But yet the Carcass is not completed, till the Quarters and Braces between the principal Posts and Posts are fitted in; the Window Frames made and set up, and the Principal Rafter's, Purlins, Gables, &c. are also fram'd and set up. The manner of their Pitch and Scantlins you will see in Plate II. And the reasons for several Pitches you may find among Books of Architecture.

teſture. But the names of every Member you will find in the *Alphabetical Table* at the later end of theſe Exerciſes on *Carpentry*, referred unto by Letters and Arithmetical Figures in the Plate aforeſaid.

But now we will ſuppoſe the Carcaſs is thus finiſhed. The Bricklayer is then to bring up the *Chimnies*, and afterwards to *Tile* the Houſe. And then the next work the Carpenter has to do, is to Bring up the *Stairs* and *Stair-Caſes*, and afterwards to *Floor* the Rooms, and *Hang* the *Doors*, &c. For ſhould he either Bring up the *Stairs* and *Stair-Caſes*, or *Floor* the Rooms before the Houſe is *Tiled* or otherwiſe covered, if wet Wether ſhould happen it might injure the *Stairs*, *Flooring*, &c.

A,

Plate II.



- A, The Ground-plate, or Ground-sell.
 BB, B B, The Principal Posts.
 C C, The Binding Intertises, or indeed more properly Interduces, Bressummers, Girders.
 D, Beam of the Roof, Bressummer, or Girder to the Garret Floor.
 E E, Principal Rafter. FF, Bressummers.
 G, Plate or Raising-piece, also a Beam.
 a a, Jaums or Door-posts. b b, Braces. c c, Jaums.
 d, Top-rail of the Balcony.
 e e, Bottom-rail of the Balcony.
 fff, Posts of the Balcony.
 g g g, Banisters.
 h h, Bressummers for the Shop-windows.
 H, King-piece or Joggle-piece.
 i i, Struts.
 k k, Top-beam, Coller-beam, Wind-beam, Strut-beam.
 l l l, Door-head.
 I I, The Feet of the principal Rafter.
 K, The Top of the Rafter.
 I I K, The Gable-end.
 L L, Knees of the Principal Rafter, to be made all of one piece with the Principal Rafter.
 M, The Fust of the House.
 N N, Purlins.
 O O, Shop-windows.
 P P, Flaps or Falls.
 m m m, Quarters.
 n n, Jaums of the Window.
 o o, Back and Head of the Window.
 p p, Transoms.
 q q, Munnions.
 r r, Furrings, or Shreadings.
 V, Single light Windows or Luteons.
 s s s, Rafter.

§ 16. Of Window Frames.

IN Brick Buildings the *Window Frames* are so framed, that the Tennants of the Head-fell, Ground-fell, and Transum run through the outer *Jaums* about four Inches beyond them: And so they are set in a Lay of Morter upon the Brick Wall before the *Peers* on either side is brought up, at about three Inches within the Front: So that the Brick work over the Head and about the *Jaums* defend it from the weather. Then the *Bricklayer* brings up the *Peers* on both sides, so that the four ends or Tennants that project through the outer *Jaums* being buried and trimmed into the Brick-work become a Fastning to the *Window-Frame*.

But if the Window-Frame stands on a Timber-house, the Head and Groundfell are sometimes Tennanted into the *Posts* of the *Carcase*; and then the Posts do the office of the outer *Jaums* of the *Window-Frame*; and the Head and Ground-fell are then called *Entertises*, and therefore both Head and Ground-fell, and *Posts* or *Jaums*, are rabbetted about half an Inch on the outside of the Front, to receive the Pane of Glass that is fitted to it. And thus (as I said) the Posts become part of the Window-Frame.

But the better way is to frame a Window as the Brick-work Window, and to project it an Inch and an half beyond the side of the Building, and to plaster against its sides, for the better securing the rest of the *Carcase* from the weather.

The Window Frame hath every one of its Lights rabbetted on its outside about half an Inch into the
Frame

Frame, and all these *Rabbets*, but that on the Ground-fell are grooved square, but the *Rabbets* on the Ground-fell is bevell'd downwards, that Rain or Snow, &c. may the freelier fall off it. Into these *Rabbets* the several Panes of Glas-work is set, and fastned by the Glasier; as shall be shewed when I come to Exercise upon *Glasing*.

The square Corners of the Frame next the Glas is Bevell'd away both on the out and inside of the Building, that the Light may the freelier play upon the Glas. And upon that Bevel is commonly Stuck a Molding (for Ornament sake) according to the fancy of the Workman, but more generally according to the various Mode of the Times.

§ 17. Of Stairs, and Stair-Cases.

SEveral Writers of *Architecture* have delivered different Rules for the Heighth and Breadth of *Steps*, and that according to the several Capacities of the *Stair-Cases*. They forbid more than six, and less than four Inches for the Heighth of each Step, and more than sixteen, and less than twelve, for the Breadth of each Step. But here we must understand they mean these Measures should be observed in large and sumptuous Buildings: But we have here proposed an ordinary private House, which will admit of no such Measures, for want of room. Therefore to our present purpose.

The first and second Pair of Stairs the Steps shall be about $7\frac{1}{2}$ Inches high, and 10 Inches broad. The third Pair of Stairs each Step may be about $6\frac{1}{2}$ Inches high, and $9\frac{1}{2}$ Inches broad. And for the fourth Pair of Stairs, each Step may be about 6 Inches high, and 9 Inches

Inches broad But this Rule they do or should follow, *viz.* to make all the Steps belonging to the same pair of Stairs of an equal height; which to do, they first consider the height of the Room in Feet and odd Inches, if any odd be, and multiply the Feet by 12, whose Product with the number of odd Inches, gives the sum of the whole Height in Inches; which summe they divide by the number of Steps they intend to have in that Height, and the Quotient shall be the number of Inches and parts that each Step shall be high. Or, if they first design the Height of each Step in Inches, they try by Arithmetick how many times the Height of a Step they can have out of the whole Height of the Story, and so know the number of Steps.

Numb. IX.

MECHANICK
EXERCISES.

O R,

The Doctrine of

Handy-works.

Applied to the Art of House-Carpentry.

By *Joseph Moxon*, a Member of
the Royal Society, and Hydrographer
to the King's most Excellent Majesty.



L O N D O N,

Printed for *Joseph Moxon*, at the Sign of *Atlas* on
Ludgate Hill. 1679.

NEW
MECHANICAL
EXERCISES

Applied to the

the Royal Society, and
to the

MECHANICK EXERCISES,

O R,

The Doctrine of *Handy-works* : applied
to the Art of *House-Carpentry*.

STairs are either made about a *Solid Newel*, or an *Open Newel*, and sometimes mixt, viz. with a *Solid Newel* for some few Steps; then a straight or *Foreright Ascent*, with *Flyers* upon the side of the square *Open Newel*, and afterwards a *Solid Newel* again. Then reiterate, &c.

The last, viz. the *Mixt Newel'd Stairs*, are commonly made in our *Party-walled Houses* in *London*, where no *Light* can be placed in the *Stair-Cafe*, because of the *Party-walls*; so that there is a necessity to let in a *Sky-light* through the *Hollow Newel*: But this sort of *Stair-Cases* take up more room than those with a single *solid Newel*; because the *Stairs* of a *solid Newel* spread only about one small *Newel*, as the several *Foulds* of the *Fans Women* use spread about their *Center*: But these, because they sometimes wind, and sometimes fly off from that winding take therefore the more room up in the *Stair-Cafe*.

The manner of projecting them, is copiously taught in many Books of *Architecture*, whither I refer you: yet not to leave you wholly in the dark; I shall give
Y you

you a small light into it. And first of the *Solid Newel*.

Winding Stairs are projected on a round *Profile*, whose Diameter is equal to the Base the Stair-Cafe is to stand on, suppose six foot square. This *Profile* hath its Circumference divided into 16 equal parts. The Semi-diameter of the Profile is divided into four equal parts, and one of them used for the Newel, and the rest for the length of the Steps: If you draw Lines from the Center through every one of the equal parts into the Circumference, the space between every two Lines will be the true Figure of a *Winding Step*. And if they were all cut out and placed one above another over the true place on the Profile round about a Newel, whose Diameter is one quarter the length of a Step, you would by supporting each Step with a *Raiser* have the model of a true pair of *Winding Stairs*. See Plate 10. Fig. 2.

Hollow Newel'd Stairs are made about a square Hollow Newel. We will suppose the *Well-hole* to be eleven foot long, and six foot wide; and we would bring up a pair of Stairs from the first *Floor* eleven foot high; it being intended that a Skie-light shall fall through the Hollow Newel upon the Stairs: we must therefore consider the width and breadth of the Hollow Newel; and in this example admit it to be two foot and a half wide, and two foot broad: by the width I mean the sides that range with the Front and Rear of the Building, and by the breadth I mean the sides that range with the Party-walls.

I find (by the Rule aforesaid) that if I assign 18 Steps up, each Step will be seven Inches and one third of an Inch high.

You must note, that the flying off, or else winding

ing of these Steps will vary their places according as you design the first Ascent. For if you make the first Ascent as you come straight out of the Street (as in Plate 10.) on the South side, you will first ascend upon a Pitch of *Flyers*, which Pitch (making an Angle of 38 deg. with the Floor) with ten Steps raise you six Foot high above the Floor, and bring you eight Foot towards the *North* end of the *Well-hole*, by making each Step ten Inches broad.

But now you must leave *Flyers*, and make four Winding Steps. These Winding Steps are made about a solid *Newel* (as hath been taught) and this *Newel* serves also for a *Post* to *Trim* the *Stair-Case* too. This *Post* stands upon the Floor, and is prolonged upwards so high, that *Mortises* made in it may receive the *Tennants* of the *Top* and *Bottom Rails* of the whole *Stair-case* for that Floor: these four Winding Steps aforesaid, rounding one quarter about the *Newel*, turns your Face in your Ascent now towards the *East*: these four steps are raised 2 foot, 5 $\frac{1}{2}$ Inches above the *Flyers*, so that (in all) your Stairs are now raised 8 foot 6 $\frac{1}{2}$ Inches. Here remains now only 2 foot 5 $\frac{1}{2}$ Inches to the *Landing place*, and these take up just four *Flyers*, which must be made as was taught before.

But now in your second pair of Stairs it will be proper to begin your Ascent with your Face towards the *West*: for landing by the first pair of Stairs with your Face towards the *East*, you turn by the side of the Rail on the second Floor from the *East* towards the *North*, and at the further end of that Rail you turn your Face again from the *North* towards the *West*, and begin your Ascent on the second pair of Stairs.

Between the Skie-light and the Ascent is a Post set upright to fasten Rails into: (to bound the Stair-case) from the bottom of which, *viz.* on the second Floor you trim up three Flyers, and then turn off a quarter of a Circle; with Winding steps: then again, Flyers to your designed pitch: and then again another quarter of a Circle with winding steps, &c.

The Rail these Steps are built upon, being at the beginning or bottom of the Ascent framed or otherwise fastned to the first upright Post, must at its higher end be framed into the next Post also, with a Bevel Tennant, as you were taught to frame *Quarters* into one another, *Numb.* 5. § 17. Only with this difference, that there you were taught to frame Square; But here you must frame upon the *Bevel*, as you were taught, *Numb.* 5. § 19. This Post aforesaid Bears upon the Floor, to make its Bearing the stronger; and this Post must be continued to such an heighth, as it may also serve to receive the Tennanted end of an upper and lower Rail framed into it. And between these *Bevelling Rails* *Bannisters* make good the outside of the *Stair-Case*.

Though I have here described this Contrivance of a pair of Stairs, yet do I not deliver it as the best Patern for this Building, or for these sorts of Stairs, nor matters it to our purpose whether it be or no; for (as I told you before) my undertaking is the *Doctrine of Handy-works*, not *Architecture*; but 'tis *Architecture* considers the best forming of all Members in a Building for the capacitie of the Ground-Plot, and the Convenience of the intended Inhabitant; but Carpenters (as Carpenters) only work by directions prescribed by the Architect.

These therefore are the common Rules that these sorts

forts of Stairs, and indeed all others with carving according to the Profile or Ground-plot of the Stairs are made by. But those that will see many Inventions may consult Books of *Architecture*, &c.

§ 18. Of Flooring of Rooms.

THough Carpenters never floor the Rooms till the Carcass is set up, and also inclosed by the Plaisterer, lest weather should wrong the Flooring; yet they generally *Rough-plain* their *Boards* for Flooring before they begin any thing else about the Building, that they may set them by to season: which thus they do, They lean them one by one on end assant with the edge of the Board against a *Bauk*, somewhat above the height of half the length of the Board, and set another Board in the same posture on the other side the *Bauk*, so that above the *Bauk* they cross one another: then on the first side they set another Board in that posture, and on the second side another, till the whole number of Boards are set an end: being set in this posture, there remains the thickness of a Board between every Board all the length, but just where they cross one another, for the Air to pass through to dry and shrink them, against they have occasion to use them: But they set them under some covered Shed, that the Rain or Sun comes not at them: for if the Rain wet them, instead of shrinking them, it will swell them; or if the Sun shine fiercely upon them, it will dry them so fast, that the Boards will *Tear* or *Shake*, wick is in Vulgar English *Split* or *Crack*.

They have another way to dry and season them,

b.

by laying them flat upon three or four Bauks, each Board about the breadth of a Board asunder, the whole length of the Bauks. Then they lay another Lay of Boards athwart upon them, each board also the breadth of a Board asunder; then another Lay athwart the last, till all are thus laid: so that in this position they also lie hollow for the Air to play between them.

Thus then, The Boards being Rough-plain'd and Season'd. They try one side flat, as by *Numb. 6. § 31.* and both the edges straight, as if they were to shoot a Joynt; as by *Numb. 4. § 4.* and cut the Boards to an exact length: because if the Boards are not long enough to reach athwart the whole Room, the ends may all lie in a straight Line, that the straight ends of other Boards laid against them may make the truer Joynt, and this they call a *Beaking Joynt*. But before they lay them upon the Floor, they try with the *Level* (described § 7.) the flatness of the whole Frame of Flooring again, lest any part of it should be *Cast* since it was first framed together: and if any part of the Floor lie too high, they with the *Adz* (if the eminency be large) take it off, as was shewed § 2. Or if it be small, with the *Jack-Plane*, in *Numb. 4. § 2.* till it lie level with the rest of the Floor. But if any part of the Floor prove hollow, they lay a Chip or some such thing upon that hollow place, to bear up the Board, before they nail it down.

All this being done, they chuse a Board of the commonest thickness of the whole Pile for the first Board, and lay it close against one side of the Room athwart the Joysts, and so nail it firmly down with two Brads into every Joyst it crosses, each Brad about

bout an Inch, or an Inch and a half within the edge of the Board.

If they should lay a more than ordinary thick or thin Board at the first, they would have a greater number of Boards to work to a Level than they need, because all the rest of the Boards must be equalized in thickness to the first.

Then they lay a second Board close to the first. But before they nail it down they again try how its side agrees with the side of the first, and also how its thickness agrees with the first Board. If any part of its edge lie hollow off the edge of the first Board, they shoot off so much of the length of the Board from that hollowness towards either end, till it comply and make a close Joynt with the first. But if the edge swell in any place, they plain off that swelling till it comply as aforesaid.

If the second Board prove thicker than the first, then with the *Adz* (as aforesaid) they hew away the under side of that Board (most commonly cross the Grain, lest with the Grain the edge of the *Adz* should slip too deep into the Board) in every part of it that shall bear upon a Joynt, and so sink it to a flat superficies to comply with the first Board. If the Board be too thin, they underlay that Board upon every Joynt with a Chip, &c.

And as this second Board is laid, so are the other Boards laid, if they be well assured the Boards are dry and will not shrink: but if they doubt the dryness of the Boards, they (sometimes do or should) take a little more pains; for after they have nailed down the first Board, they will measure the breadth of two other Boards, laying them by the side of the first. But yet they will not allow them their full room:

room to lie in, but after their edges are true shot in a streight line, they will pinch them off about half a quarter of an Inch room more or less, according as they guess at the well-seasonedness of the Boards; by nailing down the fourth Board nearer to the first Board by half a quarter of an Inch (more or less) than the breadth of both Boards are. And though it be afterwards somewhat hard to get these two Boards into that narrow room, *viz.* between the first and fourth Board, yet they help themselves thus; The under-edges of these Boards that are to joyn to each other they Bevel somewhat away, and then the first and fourth Board being fast nailed down (as afore-said) they set the outer edges of these two Boards against the two nailed Boards, letting the inner edges of the two loose Boards meet, and make an Angle perpendicular to the Floor. Then with two or three men jumping all at once upon that Angle, these two Boards with this force and reiterated jumps by degrees press flat down into the superficies of the Floor; or else with Forcing Pins and Wedges force them together: and then with Brads they nail them down, as they did the first Board. Thus afterwards they nail down a seventh Board as they did the fourth, and then fit in the fifth and sixth Boards, as they did the second and third Boards. And so on nailing down every third Board, and forcing two others between it and the last nailed Board, till the whole Floor be Boarded.

But if these Boards are not long enough (as I hinted before) to reach through the whole Room, they examine how true the ends lie in a straight line with one another, by applying the edge of the Two-foot Rule to the ends and where the ends of any Boards
keep

keep off the edge of the Two-foot Rule from complying with the whole range of ends, they with the *Chissel* and *Mallet* cut off that irregularity, holding and guiding the *Chissel* so that it may rather cut away more of the bottom than top of the Board, that so the Boards joyned to the ends of the first laid Boards, may make on the Superficies of the Floor the finer and truer Joynt.

Having thus Boarded the whole Room, notwithstanding they used their best diligence to do it exactly, yet may the edges of some Boards lye somewhat higher than the Board it lies next to : therefore they peruse the whole Floor, and where they find any irregularities they plane them off with the Plane, &c.

§ 19. *The Hanging of Doors, Windows, &c.*

THE Floors being Boarded, the next work is to *Hang* the *Doors*, in which though there be little difficulty, yet is there much care to be taken, that the Door open and shut well.

If the Door have a *Door-Case* (as Chamber-Doors, and Closet-Doors commonly have) the *Jaums* of the Door Case must stand exactly perpendicular, which you must try by the Plumb-line. as by § 8. and the Head of the Door Case or Entertise must be fitted exactly square to the *Jaums*, as you were taught *Numb. 5. § 17, 18, 19.* and the Angles of the Door must be made exactly square, and the *Rabbets* of the Door to fit exactly into the *Rabbets* of the Door-Case. But yet they commonly make the Door about one quarter of an inch shorter than the insides of the *Jaums* of the Door-Case, lest if the Boards of the Floor chance to swell within the sweep of the Door, the bottom

of the Door should drag upon the Floor.

They consider what sort of Hinges are properest for the Door they are to *Hang*. When they have a *Street-door* (which commonly is to take off and lift on) they use *Hooks* and *Hinges*. In a *Battend-door*, *Back-door*, or other *Battend-door*, or *Shop-windows*, they use *Cross-Garnets*. If a *Fram'd Door*, *Side Hinges*: And for *Cup-board Doors* and such like, *Duf-Tails*. (See the description of these Hinges in *Numb. 2. Fig. 1. §. 6.*) But what sort of Hinges soever they use, they have care to provide them of a strength proportionable to the size and weight of the Door they hang with them. Well-made Hinges I have descibed *Numb. 2. fol. 20.* Whither to avoid repetition I refer you.

If they Hang a *Street-door* (which is commonly about six foot high) they first drive the Hooks into the *Door-Post*, by entering the Post first with an *Augure*: But the *Bit* of the *Augure*, must be less than the Shank of the Hook, and the hole boarded not so long, because the Shank of the Hook must be strongly forced into the *Augure-hole*, and should the *Augure-hole* be too wide, the Shank would be loose in it, and not stick strong enough in it. Therefore if the Shank be an Inch-square, an half-Inch-*Augure* is big enough to bore that hole with, because it will then endure the heavier blows of an Hammer, to drive it so far as it must go; and the stronger it is forced in, the faster the Hook flicks. But yet they are careful not to split the *Door-Post*.

These Hooks are commonly drove in about Fifteen Inches and an half above the *Ground-sell*, and as much below the top of the Door. It is or should be their care to chuse the Pin of the lower Hook

Hook about a quarter of an Inch longer than that they use for the upper Hook (or else to make it so) because these Doors are commonly un-weildy to lift off and on, especially to lift both the Hindges on both the Hooks at once. Therefore when the lower Hinge is lifted on the lower Hook, if the Door be then lifted perpendicularly upright, so high as the under side of the upper Hinge may just reach the top of the upper Hook, you may the easier slip the Eye of the upper Hinge upon the Hook; whereas, if the lower Hook be either shorter, or just no longer than the other; instead of lifting it readily upon the upper Hook, you may lift it off the lower Hook, and so begin the labour again.

Having drove in the Hooks they set the *Rabbits* of the Door within the *Rabbits* of the Door Posts, and underlay the bottom of the Door, with a Chip or two about half a quarter of an Inch thick, to raise the Door that it Drag not. Then they put the Eyes of the Hindges over the Pins of the Hooks, and plaing the Tail piece of the Hindges parallel to the bottom and top of the Door, they so nail them upon.

This is the Rule they generally observe for Hanging Doors, Shop-windows, &c. Only, sometimes instead of Nailing the Hindges upon the Door, they *Rivet* them on, for more strength. And then, after they have fitted the Door or Window into its *Rabbits*, and laid the Hindges in their proper place and position (as aforesaid) they make marks in the Nail holes of the Hinge with the point of their Compasses upon the Door, and at those marks they Pierce-holes, with a *Piercer-Bit*, that fits the shank of the *Rivet*; then they put the shank of the

Z. 2

Rivet.

Rivet through the holes made in the Door; yet so that the Head of the Rivet be on the outside of the Door; and they also put the end of the Shank into the Nail-hole of the Hinge, and so while another man holds the Head of the Hatchet against the Head of the Rivet, they with the *Pen* of their *Hammer* batter and spread the flat end of the Shank over the Hole, as was shewn. Numb. 2. fol. 24, 25.

The Titles of some Books of Architecture.

Sebastion Seirlio, in Folio.

Hans Bloom's Five Columns, Folio.

Vignola, in Folio.

Vignola, Or the *Compleat Architect*, in Octavo

Scamotzi, Quarto.

Palladio, Quarto.

Sir *Henry Wotton's* Elements of Architecture, Quarto.

These Books are all Printed in English: But there are many others extant in several other Languages, of which *Vitruvius* is the chief: For from his Book the rest are generally derived; as *Philip Le Orm*, *Ditterlin*, *Marlois*, and many others, which being difficult to be had among Book-sellers, and these sufficient for information, I shall omit till another opportunity.

An *Explanation of Terms* used in *Carpentry*.

A.

A *Dz*, Plate 8. B § 2.

Arch, Any work wrought Circular, as the top part of some Window-frames, the top of some great Gates, the Roof of Vaults, &c.

Architrave, See Numb. 6. Plate 6. 1. and Plate 6.

A. § 1.

Ax, Numb. 7. Plate 8. A.

B.

B *ack* or *Hip-molding*. The backward Hips or *Valley-Rafter* in the way of an Angle for the back part of a Building.

Bannister, Numb. 8. Plate 11. g g g.

Base is commonly the Bottom of a Collumn. See Numb. 6. Plate 6. b. and Plate 7. B.

Batement, To abate or waste a piece of Stuff, by forming of it to a designed purpose. Thus instead of asking how much was cut off such a piece of Stuff, Carpenters ask what *Batement* that piece of Stuff had.

Batter, the side or part of the side of a Wall, or any Timber that bulges from its bottom or foundation, is said to *Batter* or *hang over* the Foundation.

Battlement, A flat Roof or Platform to walk on. But Battlements are more properly Walls built about the Platform to inclose it, as is seen upon Towers for defence: Part of the Battlement being Breast

Breast high that Musquetiers may shoot over it, the other part Man-high, to secure Men from the shot of their enemies.

Bauk a peece of Fir unsplit, from four to ten Inches square : and of many lengths.

Bear, Timber is said to *Bear* at its whole length when neither a Brick wall or Posts &c. stand between the ends of it. But if either a Brick wall or Posts, &c. be Trimmed up to that Timber, then it is said to Bear only at the distance between the Brick-wall or Post and either end of the Timber. Thus Carpenters ask what

Bearing such a peece of Timber has? the answer is 10, 12, 15, &c. Foot, according to the length of the whole Timber, or else according to the distance between either end of the Timber, and a

Bearer, viz. a Post or Brick-wall that is Trimmed up between the two ends of a peece of Timber, to shorten its *Bearing*.

Bond, when workmen say make good Bond, they mean fasten the two or more peeces of Timber well together, either with Tennanting and Mortessing, or Duff-railing, &c.

Binding Joists, See Trimmers, or Plate 10. *b b b*.

Brace, See Plate 11. *b b b*.

Brad, is a Nail to Floor Rooms with, they are about the size of a Ten-penny Nail, but have not their heads made with a shoulder over their shank, as other Nails, but are made pretty thick towards the upper end, that the very top of it may be driven into, and buried in the Board they nail down, so that the tops of these Brads will not catch (as the Heads of Nails would) the Thrums of the Mops when the Floor is washing. You may see them at most Ironmongers.

Break

Break in, Carpenters with their Ripping Chissel do often *Break in* to Brick walls: that is, they cut holes, but indeed more properly break the Bricks by force, and make their hole to their size and form.

Bressummer, See Plate 11. CC, D, FF, *h h*.

Bring up, A term most used among Carpenters, when they discourse *Bricklayers*; and then they say, *Bring up* the Foundation so high, *Bring up* such a wall, *Bring up* the Chimnies, &c. which is as much as to say, Build the Foundation so high, Build the wall; Build the Chimnies, &c.

Butment, The peece of Ground in the yard marked, G in Plate 10. is a *Butment* from the rest of the Ground-Plot.

Buttress, that stands on the outside a wall to support it.

C

C*amber*, A peece of Timber cut Arching, so as when a weight considerable, shall be set upon it, it may in length of time be reduced to a straight.

Cantilevers, Peeces of Wood framed into the Front or other sides of an House to sustain the Molding and Eaves over it.

Carcass, is (as it were) the Skelleton of an House, before it is Lath'd and Plaistered.

Cartouses, Ornamented *Corbels*.

Cleer Story Window, Windows that have no Transum in them.

Commander, See Numb. 7. Plate 8. K and § 10.

Coping over is a sort of hanging over, but not square to its upright, but Bevelling on its under side, till it end in an edge.

Corbel,

Corbel, A peece of Timber set under another peece of Timber, to discharge its Bearing.

Crab, The Engine described Plate 9. E. and B C D several of its Appurtenances, viz. B C C *Snatch Blocks*. D *Levers*. Its Office is to draw heavy Timber to a considerable heighth.

Crow, See Plate 8. I. Its Office is to remove heavy Timber, and therefore for strength is made of Iron.

Crown Post, See Plate 11. H. Also the *King Peece*, or *Joggle peece*.

D

D*ischarge*, A Brick-wall or a Post trim'd up to a peece of Timber over charg'd for its Bearing, is a Discharge to that Bearing.

Dormer, Plate 11. Q R.

Double Quarter, See *Quarter*.

Draft, The Picture of an intended Building described on Paper, whereon is laid down the devised Devisions and Partitions of every Room in its due proportion to the whole Building, See Numb. 7. § 13.

Drag, A Door is said to *Drag* when either by its ill Hanging on its Hinges, or by the ill Boarding of the Room, the bottom edge of the Door rides (in its sweep) upon the Floor. See § 19.

Dragon beams are two strong Braces or Struts that stands under a Bressummer, meeting in an angle upon the shoulder of the *King peece*. In Plate 11. i i are *Dragon beams*.

Draw knife, described Plate 8. E and § 5.

Draw Pins, described Plate 8. F and § 6.

Drug, described Plate 9. E and § 12.

Enter,

E

Enter, When Tennants are put into Mortesses, they are said to Enter the Mortesses.
Enterduce or Entertise described Plate 11 C C.

F

Feather-edge, Boards or Planks that have one edge thinner than another are called *Feather edge* stuff.

Fir Pole, A sort of stuff cut off the Fir tree, small and long, commonly from 10 to 16 Foot. They are sometimes used in sleight Buildings, to serve instead of Bauks and Quarters.

Flyers, are Stairs made of an Oblong square Figure, whose fore and backsides are parallel to each other; and so are their ends: the second of these *Flyers* stands parrallel behind the first, the third behind the second, and so are said to fly off from one another.

Floor, In *Carpentry*, it is as well taken for the Fram'd work of Timber, as the Boarding over it.

Foot-pace, is a part of a paire of Stairs, whereon after four or six steps you arrive to a broad place, where you may take two or three paces before you ascend another step; thereby to ease the legs in ascending the rest of the steps.

Furrings, The making good of the Rasters Feet in the Cornice.

G

Gable or Gable end, in Plate 11. II K.
Gain, The bevelling shoulder of a Joynt or other
 A a

ther Stuff: It is used for the Lapping of the end of a Joyst &c. upon a Trimmer or Girder, and then the thickness of the shoulder is cut into the Trimmer also Bevilling upwards, that it may just receive that *Gain*, and so the Joyst and Trimmer ly even and level upon their superficies. This way of working is used in a Floor or Hearth,

Girder, described Plate 10 Q Q.

Ground Plate, described Plate 11 A.

Ground Plot, The peece of Ground a Building is to be erected upon.

H

H *Ang over*, See *Batter*.

Hips, described Plate 11. E E, They are also called *Principal Rafter*s, and *Sleepers*.

Hook-pin described Plate 8. F.

I

J *ack*, described Plate 8. M. An Engine used for the removing and commodious placing of great Timber.

Jack-Plain called so by Carpenters, but is indeed the same that Joiners call the *Fore Plain*, See Numb. 4. § 2. and Plate 4 B 1.

Jaums, Door Posts are so called: So are the up-right outer Posts of a Window frame, See Plate 11. a a a a, c c, n n.

Joggle peece, See Plate 11. H.

Joysts, See Plate 10 a a a a.

Juffers, Stuff, about 4 or 5 inches square, and of several Lengths.

King

K

K *Ing peece*, See *Joggle peece*.

Kerf, See *Explanation of Terms* in Numb. 6.

Knee, A peece of Timber growing angularly, or crooked, that is, a great Branch shooting out neer the top of the Trunk of the Tree, and is so cut that the Trunk and the Branch make an angle; as in Plate 11. E L; being made out of one peece of stuff: it is called a *Knee-peece*, or *Knee-Rafter*,

L

L *Anding-place*, is the uppermost Step of a pair of Stairs, viz. The Floor of the Room you ascend upon.

Skirts, Projecting of the Eaves.

Level, See Plate 8. G and § 7.

Lever, See Plate 9. D.

Lintel, In Brick-Buildings Carpenters lay a long piece of Timber over the Peers, to Trim with the Window-Frame; as well to Bear the thickness of the Brick-wall above it, as to make Bond with the sides of the Walls.

Long-Plain, The same that Joyners call a *Joynter*. See Numb. 4. B 2 § 4.

Luthern, See *Dormer*.

M.

M *Odillon*, See *Cantelever*.

Molding, Moldings are stuck upon the edges of stuff to Ornament it: As on Chimney-pieces, the

A a 2

inner

inner edges of Window-frames, Shelves, &c. See *Numb. 4. §. 9.*

Munnion, the upright Posts that divide the several Lights in a Window-frame, are called *Munnions*. See Plate 11. *q q q.*

N

N*ewel*, the upright Post that a pair of Wind-ing-stairs are turned about.

P

P*itch*, The Angle a Gable-end is set to, is called the *Pitch* of the Gable-end.

Planchier, An Ornament to which the Cornice is fastned.

Plate, A piece of Timber upon which some considerable weight is framed, is called a Plate. Hence *Ground-Plate*, Plate 11. A. *Window-Plate*, &c.

Pumb-line described, Plate 8 H § 8.

Posts, See *Principal Posts*.

Prick-Posts, Posts that are framed into *Bres-summers*, between Principal-posts, for the strengthening of the Carcass.

Principal-Posts, The Corner Posts of a Carcass, See Plate 11. B B.

Profile, The same with *Ground-Plot*.

Projecture, is a jetting over the upright of a Building; Thus *Balconies* project into the Street.

Puncheons, Short pieces of Timber placed under some considerable weight to support it.

Pudlaies,

Pudlaies, Pieces of Stuff to do the Office of Hand-Spikes.

Purlins, See Plate 11. NN.

Q.

Quarters are *single* and *double*. *Single Quarters* are Sawen stuff, Two Inches thick, and Four inches broad. The *Double-Quarters* are sawen to Four Inches square.

Quartering, In the Front of the third Story in Plate 11. All the Work except the Principal Posts, Jaums, and Window-frames, *viz.* The upright Trimming and the Braces is called *Quartering*.

Quirk, A piece taken out of any regular Ground-plot, or Floor: For example, The whole Ground-plot A B C D. in Plate 10 is a regular Ground-plot. But if the piece K be taken out of it, K shall be a *Quirk*.

R.

R After, See Plate 11. cccc.
Rail, Rails stand over and under Bannisters of *Balcnies*, Stair-Cases, &c.

Raiser, is a Board set on edge under the Foreside of a step.

Raising-piece, Pieces that lye under the Beams upon Brick or Timber by the sides of the House.

Rellish, See *Projecture*.

Return, Either of the adjoining sides of the Front of an House or Ground-plot, is called a *Return-side*, as in Plate 10. the Front is A B, the *Return-sides* to this Front is A C and B D,

Ridge,

Ridge, the meeting of the Rafters on both sides the House is called the *Ridge*.

Ripping Chissel, See Plate 8 D & 4.

Roof, The Covering of a House; But the word is used in Carpentry for the Timber work of the Covering.

S

S*cribe*, See Number 6. in *Explanation of Terms*.
Shake, Such Stuff as is crackt either with the heat of the Sun or the draught of the wind, is called *Shaken Stuff*.

Shingles, Small peeces of wood used to cover Houses with, instead of Tiles or Slates.

Shreadings, See Plate 11. the lower end of the Principal Rafters markt *rr* are called *Shreadings*, or *Furrings*.

Sleepers, The same with *Purlins*.

Snatch-blocks, See Plate 9 B C C.

Socket Chissel, Described Plate 8 and § 3.

Soils or Sells, are either *Ground Sells* described Plate 11. A. or *Window Sells* which are the bottom Peeces of Window Frames.

Stair Case, The inclosure of a pair of Stairs, whether it be with Walls, or with Walls and Railes and Bannisters, &c.

Stancheons, See *Puncheons*.

Strut, See *Dragon beam*.

Summer, In Plate 10. P P is a *Summer*, whereinto the Girders are Tennanted.

T

T*enfoot Rod*, See § 13.

Transom, The Peece that is framd a-crofs a double.

ble Light Window, See Plate II. P P.

Trim, When workmen fit a peece into other work, they say they *Trim* in a peece.

Trimmers, See Plate 10 *b b b b*.

Truss, See *King peece*, or *Joggle peece*.

Tusk, A Bevel shoulder, made to strengthen the Tennant of a Joyst, which is let into the Girder.

V

V *Alley Rafter*, See *Back* or *Hip Molding*.

W

W *Ell hole*, See Plate 10. I.

Wall Plate, In Plate 10. A C, B D and N O are *Wall Plates*.

Thus much of *Carpentry*. The next *Exercises* will (God Willing) be upon the Art of *Turning*, *Soft Wood*, *Hard Wood*, *Ivory*, *Brass*, *Iron*, &c. With several Inventions of *Oval work*, *Rose work*, *Rake work*, *Angular work*, &c.

F I N I S.

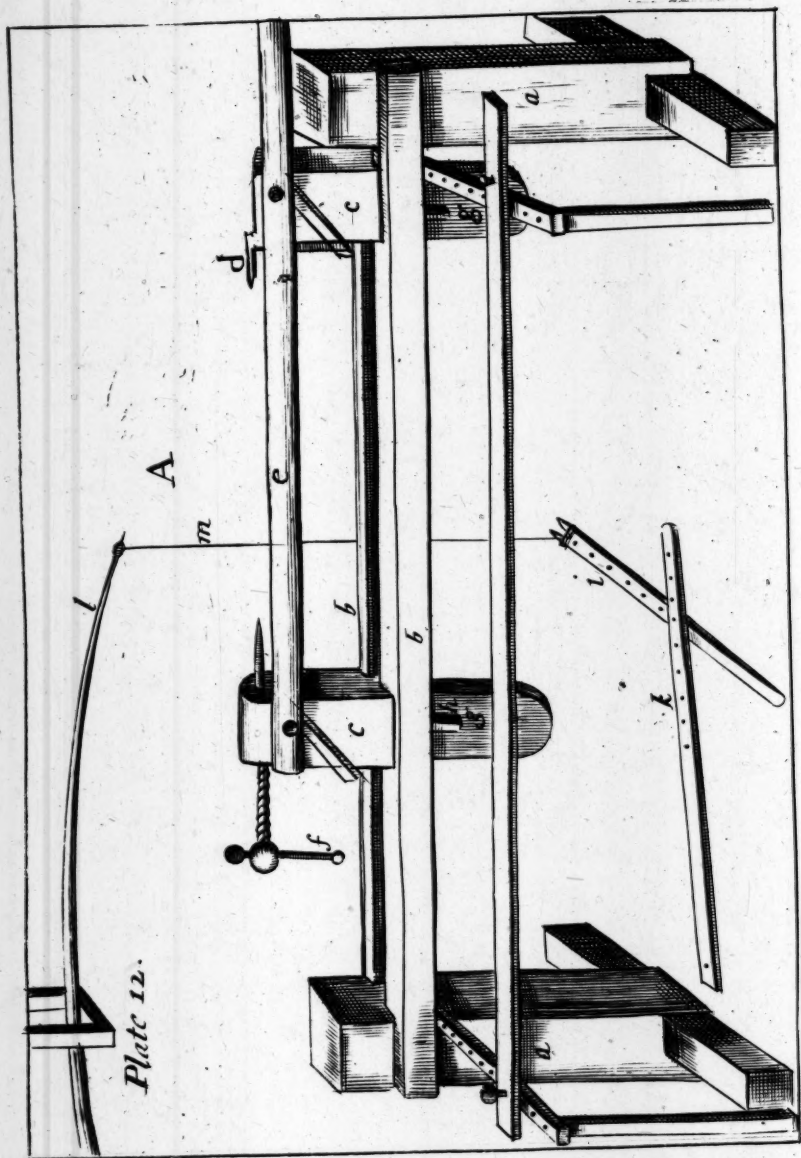
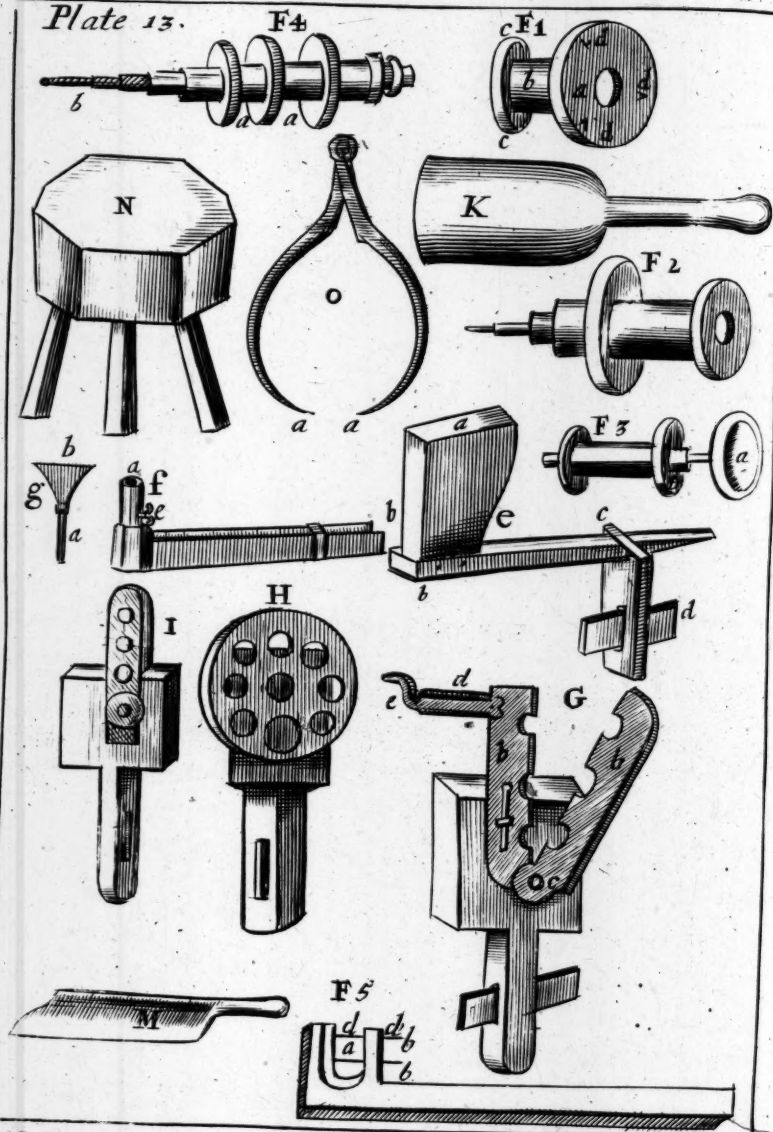


Plate 13.



Numb. X.
MECHANICK
EXERCISES,
OR
The Doctrine of
Handy-Works.

Applied to the Art of *T U R N I N G*.

By *Joseph Moxon*, Member of the *Royal Society*, and *Hydrographer* to the
Kings most Excellent Majesty.



LONDON,

Printed for *Joseph Moxon* at the Sign of *Atlas* on *Ludgate-Hill*, 1680.



MECHANICK EXERCISES,

O R,

The Doctrine of

Handy-works,

Applied to the Art of *TURNING*.

Of Turning.

AS by placing one Foot of a pair of Compasses on a Plain, and moving about the other Foot or point, describes on that Plain a Circle with the moving point; so any Substance, be it *Wood, Ivory, Brass, &c.* pitcht steddy upon two points (as on an *Axis*) and moved about on that *Axis*, also describes a Circle Concentrick to the *Axis*: And an Edg-Tool set steddy to that part of the outside of the aforesaid Substance that is nearest the *Axis*, will in a Circumvolution of that Substance, cut off all the parts of Substance that lies farther off the *Axis*, and make the outside of that Substance also Concentrick to the *Axis*. This is a Brief Collection, and indeed the whole Sum of *Turning*.

Now, as there is different Matter or Substance to be *Turned*, so there is also different Ways, and different Tools to be used in *Turning* each different Matter.

B b

The

The different Matters are *Soft Wood, Hard Wood, Ivory, Brass, Iron, &c.* each of which (when I have described the Turners Tools for Soft Wood) I shall discourse upon. But,

§ I. Of the Lathe.

THE *Lathe* is described in *Plate 12. A.* This Machine is so vulgarly known, that though it cannot be described in Draft, so as all its parts shall appear at one single View, yet enough of it to give you the Names of its several Members, and their Uses are represented: viz.

a a a a The *Legs* or *Stiles*.

b b The *Cheeks* or *Sides*.

c c The *Puppets*.

d The *Screw*.

d The *Pike*.

e The *Rest*.

f The *Handle* of the *Screw*.

g The *Tennants* of the *Puppets*.

h The *Wedge*.

i The *Treddle*.

k The *Cross-Treddle*.

l The *Pole*.

m The *String*.

n The *Horn*.

¶ I. Of the *Legs, or Stiles*.

THE *Legs* or *Stiles* are commonly about two Foot and ten Inches high, and are set perpendicularly upright; having each of them a *Tennant* on its upper end, of the thickness the two *Cheeks* are to

to stand asunder : And on either side the Shoulder of these two *Tennants* is laid one of the *Cheeks* close to the sides of the *Tennants*, and so pinned close to the *Tennants* as was taught Numb. 5. §. 17. But a steddier and more secure way, is to have a strong Iron Screw made with a square Shank near the Head, that when it enters into a square hole made fit to it in the hithermost *Cheek*, it may not twist about, but by the Turning about of an Iron Nut, upon the fore end of the Screw, the Nut shall draw the two *Cheeks* close to the two sides of the *Tennants*, or the upper ends of the *Legs*.

¶ 2. Of the Checks.

AS I told you, the *Legs* are to be set up directly perpendicular, so the *Cheeks* are to be fastned directly Horizontally upon them : And the *Legs* and *Cheeks* are to be fastned with *Braces* to the Floor and other parts of the Room the *Lathe* stands in, according to the convenience of the Room for fastning, that the whole *Lathe* may stand as steddly and solid as may be. For if with *Turning* large Work the strength of the Tread should make the *Lathe* tremble, you will not be able to make true and neat Work ; but the Tool will job into softer parts of the Stuff, and fly off where a Knot or other harder parts of the Stuff comes to the Tool.

¶ 3. Of the Puppets.

THE *Puppets* are square pieces of Wood, of a Substance convenient to the light or heavy work they intend to Turn : And *Turners* will rather

have their *Puppets* too strong than too weak; because, though the *Puppets* be very strong, yet they can turn light work with them; whereas if they be weak they cannot turn Heavy work with them: For the weight of heavy unequal tempered Stuff running about, will be apt both to shake the *Puppets*, and loosen the small hold of the *Wedge* in the *Tennant*; by either of which Inconveniencies the Work in the *Lathe* may tremble, as aforesaid.

And though no size for the height of the *Puppets* can be well asserted, because of the several Diameters of Work to be *Turned*, yet Workmen generally covet to have their *Puppets* as short as they well can, to bear their Work off the *Cheeks* of the *Lathe*, because these *Puppets* stand the firmer, and are less subject to loosen. But then, if the Diameters of the work be large, the *Puppets* may be too short to *Turn* that work in: For the *Pikes* of the *Puppets* must stand somewhat more than half the Diameter of the Work above the superficies of the *Cheeks*. Therefore *Turners* have commonly two or three pair of *Puppets* to fit one *Lathe*, and always strive to use the shortest they can to serve their Work, unless the shortness of the *Leggs* of the *Lathe*, makes the work fall too low for the pitch of the Workman that is to work at the *Lathe*. Therefore in the making of the *Lathe* the height of the *Legs* with relation to the intended work, and height of the Workman, are to be well considered.

At the lower end of these *Puppets* are made two *Tennants*, of such a thickness, that they may easily slide in the *Groove* between the two *Cheeks*, and so long, that a *Mortise* through it of the length of the *Cheeks* depth, and a sufficient strength of Wood below

low it may be contained. Into this *Mortefs* is fitted a *Tapering-Wedge*, somewhat less at the fore end and bigger at the hinder end than the *Mortefs*, that as it is forced into the *Mortefs* with a *Mallet* or a *Maul*, it may draw the bottom Shoulder of the *Puppet* close and firmly down upon the *Cheeks*, that they may neither joggle or tremble in working.

¶ 4. *Of the Horn.*

U Pon the Right Hand *Puppet* on the out side near the top of it, is hung the Tip-end of an *Horn* with its Tip downwards, to hold Oyl in, and ought to have a Wooden round *Cover* to fit into it, that neither Chips or Dirt get in to spoil the Oyl; and in the handle of the *Cover* should be fitted a wooden *Button*, which may serve for an *Handle* to the *Cover*: And through this *Button* should be fastened an Iron Wyer to reach almost to the bottom of the *Horn*: This Wyer stands always in the Oyl, that so oft as the Workman has occasion to oyl the Centers of his Work, to make his work slip about the easier, he takes the wooden *Cover* by the *Button*, Wyer and all, and with the end of the Wyer Oyls his Center-holes, and pops his Wyer and *Cover* again into the *Horn* against he has occasion to use it the next time.

¶ 5. *Of the Pikes and Screw.*

N Ear the upper end of one of these *Puppets* is fastened a strong Iron *Pike*, but its point is made of tempered Steel; and near the upper end of the other *Puppet* is fitted an Iron *Screw* quite through a

Nut in the *Puppet*, whose point is also made of Temper'd Steel. This *Iron Pike* in one *Puppet*, and the *Screw* in the other *Puppet* are so fitted into the *Puppets*, that their *Shanks* lie in a straight *Line* with one another, and both their points lie also in that straight *Line* pointing to one another: And in the *Head* of the *Iron Screw* is a *Hole* where-into is fitted an *Iron Handle* about seven or eight *Inches* long, with a round *Knob* at each end of it that it slip not through the hole in the *Head*. This *Iron Handle* is to turn about the *Screw* forward or backward as your purpose shall require.

Upon the points of this *Screw* and *Pike* the *Centers* of the *Work* are pitcht, and afterwards screw'd with the *Screw* hard, and so far into the *Stuff*, that it may not slip off the points in working, especially if it be soft *Wood*, and the work large and heavy.

Also, near the upper end of these *Puppets*, upon that side the *Workman* stands when he works, the *Wood* of the *Puppets* is wrought away to square flat *shoulders* somewhat below the *Pikes*, that the *Rest* may (if occasion be) lie near the *Pikes*, and bear steady upon the *Shoulders*.

¶ 6. Of the Rest.

THE *Rest* is a square piece of *Stuff* about an *Inch* or an *Inch* and half thick, and two *Inches*, or two and an half broad, and somewhat longer than the distance between the *Puppets*. Its *Office* is to rest the *Tool* upon, that it may lie in a steady position while the *Workman* uses it.

¶ 7. Of

¶ 7. Of the Side-Rest.

BUT besides this *Rest*, *Turners* have another *Rest*, called the *Side-Rest*. This they use when they *Turn* the flat sides of Boards; because the flat side of Boards standing athwart the *Pikes*, and this *Rest* standing also athwart the *Pikes*, they can the more conveniently rest their Tool upon it. It is marked e in *Plate 13*, and is in the *Plate* disjunct from the *Lathe*; as well because it and the Common *Rest* cannot both together be exprest in Picture, as also because it is made to take off and put on as occasion requires.

The *Rest* is marked *a*, and is a piece of an Oaken plank or Elm plank, about two Inches thick, and stands so high above the *Cheeks* of the *Lathe* as the *points* of the *Pikes* do, or sometimes a little higher: Its Breadth is about a Foot or more or less, as the Work requires, or the Workman fancies. The Bottom of it is firmly nailed to one side of a Quarter of Oak or Elm of about three Inches square, and two Foot, or two Foot and an half long, close to one end, as you see in the Figure at *b*, so as the *Rest* stand upright to the piece of Quarter. This piece of Quarter is as a *Tennant* to slide into a square Iron Collar marked *c*; This square Iron Collar is made so long as to reach through the depth of the *Cheeks* of the *Lathe*, and to receive the Quarter or *Tennant* thrust through it above the *Cheeks*, and a *Wedge* under the *Cheeks* marked *d*, which *Wedge* (when stiff knock'd up) draws the *Tennant* strong and firmly down to the *Cheeks*, and consequently keeps the *Side-rest* steady on any part of the *Cheeks*, according

ding as you slide the *Collar* forwards or backwards towards either *Pike*, or as you thrust the *Rest* nearer or farther to and from the *Pikes*.

Some *Turners* for some Work, instead of a plank for this *Rest*, fasten to one end of the *Quarter* or *Tenant*, a long Iron with a round Cilindrick *Socket* in it, as at the Figure marked *f* in *Plate 13*, *a* is the *Socket* of about an Inch or an Inch and an half Diameter, to reach within two or three Inches as high as the *Pikes*, and into this *Socket* they put a long round Iron *Shank*, as in Figure *g* of the same *Plate*, *a* is the *Shank*, and at the top of this *Shank* is made the *Rest*, marked *b*. This *Shank* (I say) slips easily into the *Socket*, that it may be raised or let down as occasion requires, and by the help of a *Screw* through the *Socket* at *e*, may be fastned at that length.

The *Rest*, (by reason of its round *Shank*) may be also turned with its upper edge more or less oblique or athwart the Work, or else parallel to the Work, according as the purpose may require.

Near one end of the *Rest* is fitted and fastned a piece of Wood about an Inch square, and ten or twelve Inches long: This piece of wood is fitted stiff into a square Hole or Mortise made in the *Puppet*, a little above the *Shoulder* for the *Rest*, to set the *Rest* to any distance from the *Pikes*, which, with the ends of wooden *Screws* entred into wooden *Nuts* on the further side of the *Puppet*, and coming through against the *Rest*, keeps the *Rest* from being thrust nearer to the work when the Workman is working.

¶ 8. Of the Treddle and Cross-Tredden.

ABout the middle between the ends, is placed a wooden *Tredden* about two Inches and an half broad, an Inch thick, and three Foot long, and sometimes three and an half, to four Foot long. The hinder end of it is fastned to the Floor, with a piece of Leather (sometimes a piece of the Upper-leather of an old Shoe, which piece of Leather is nailed to the under-side of the hinder end of the *Tredden*, so as to leave Leather enough beyond the end of the *Tredden* to nail down upon the Floor; which *Tredden* being thus nailed down, will move upwards, as the Spring of the *Pole* draws up the *String*; the *String* being also fastned to the fore-end of the *Tredden*.

The hinder end of the *Tredden* is nailed down about a Foot or a Foot and an half behind the *Lathe*, and about the middle between both the *Legs*, so that the fore-end of the *Tredden* reaches beyond the fore-side of the *Lathe*, about a Foot and an half or two Foot. And note, that the farther the Fore-end of the *Tredden* reaches out beyond the Fore-side of the *Lathe*, the greater will the sweep of the Fore-end of the *Tredden* be, and consequently it will draw the more *String* down; and the more *String* comes down at one *Tread*, the more Revolutions of the Work is made at one *Tread*, and therefore it makes the greater rid-dance of the Work.

But then again, if the Fore-end of the *Tredden* reach too far before the Fore-side of the *Lathe*, it may draw the end of the *Pole* so low as to break it: and it will also be the harder to *Tread* down, because the power commanding (which is the weight of the

C c

Tread)

Tread) lies so far from the weight to be commanded, which is the strength of the *Pole*, augmented by the distance that the end of the *Treddle* hath from the Work in the *Lathe*; so that you may see, that the nearer the Fore-end of the *Treddle* lies to the Perpendicular of the Work in the *Lathe*, the easier the *Tread* will be: And some *Turners* that *Turn* altogether Small Work, have the Fore-end of the *Treddle* placed just under their work; so that their *String* works between the *Cheeks* of the *Lathe*; But then the Sweep of the *Treddle* being so small, the *Pole* draws up but a small length of *String*, and consequently makes the fewer Revolutions of the Work in one *Tread*, which hinders the riddance of the Work: unless with every Spring of the *Pole*, they should lift their Treading Leg so high as to tire it quickly with bringing it down again, after it is raised to so uncommodious a position.

This *Treddle* hath a square Notch in the middle of the further end, about an Inch and an half wide, and two Inches long, that the end of the *String* may be wound either off or on the Wood on either side the Notch, to lengthen or shorten the *String*, as the different Diameters of the Work shall require.

About the middle of the *Treddle* is fixed a round Iron Pin about half an Inch in Diameter; so as to stand upright about an Inch and an half or two Inches long above the *Treddle*. And under the *Cheeks* is also fixed down the *Cross-Treddle*, which is such another piece of Wood as the *Treddle* is, but longer or shorter, according to the length of the *Lathe*: And in the middle of the Breadth of the *Cross-Treddle* is made several holes all arow to receive the Iron Pin set upright in the *Treddle*. These holes are commonly

ly boarded about two or three Inches assunder, that the *Pin* on the *Treadle* may be put into any one of them, according as the *String* is to be placed nearer to or further off either end of the *Lathe*.

¶ 9. Of the Pole.

THE *Pole* is commonly made of a *Fir-pole*, and is longer or shorter, or bigger or smaller, according to the weight of the Work the Workman designs to *Turn*: For the thicker the *Pole* is, the harder must the *Tread* be to bring it down; and for this reason, if the *Pole* prove too strong for their common or continued Work, they will weaken it by cutting away (with a Draw-knife, described Numb. 7. Plate 8. E, and § 5.) part of the substance off the upper and under side of the *Pole*.

The thick end of this *Pole* is nailed (or indeed rather pinned) up to some Girder or other Timber in the Ceiling of the Room, with one single Nail, or a Pin, that the *Pole* may move upon that Nail or Pin, as on a Center, and its thin end pass from one *Puppet* to the other, as the Work may require. And at about a Foot distance or more, is also nailed up to some Joysts or other Timbers of the Ceiling, two *Cheeks* of a convenient strength, and at the lower end of these two *Cheeks* is nailed a Quarter or Batten to bear the *Pole*, though the weight of a *Tread* be added to it, as you may see at *nn* in Plate 12.

¶ 10. Of the Side-Rest.

BUt it sometimes happens that the Ceiling of the Work-room is not high enough for the *Pole* to play

play upwards and downwards; Therefore in such case, they place the thin end of the *Pole* at some considerable distance off the *Lathe*, either before or behind it, and so make the Spring of the *Pole* Horizontal towards the *Lathe*, conveying and guiding the *String* from the *Pole* to the Work by throwing it over a *Rowler*, moving on two Iron *Center-pins* fastned at both ends, and placed parallel to the *Cheeks* of the *Lathe*, above the Work as high as they can; and thus every *Tread* draws the *Rowler* about: But should the *Rowler* not move about upon these Iron *Pins*, the *String* every *Tread* would both cut a Groove in the *Ruler*, and fret it self more or less upon the *Rowler*.

¶ 11. Of the Bow.

SOME *Turners* that work light Work, such as *Cane-Heads*, *Ink-horns*, &c. for which they need scarce remove the *Puppets* off their *Lathe*, use a Common *Bow*, such as Archers use. The middle of this *Bow* they fasten over Head, with its *String* Horizontally downwards, and in the middle of that *String* they fasten another *String* perpendicularly downwards, whose other end they fasten to the *Treddle*, and the *String* wound round their Work brings it about.

¶ 12. Of the Great Wheel.

BUT when *Turners* work Heavy Work, such as the *Pole* and *Tread* will not command, they use the *Great Wheel*. This Wheel is so commonly known, that I shall need give you no other description of it than the Figure it self, which you may see in *Plate 14. a.* It is turned about with one, and sometimes with

with two Iron *Handles*, according as the weight of the Work may require.

Its *String* hath both its ends strong and neatly fastened together, not with a Knot, but lapt over one another about three Inches in length, and so is firmly whipt about with small Gut, that it may the easier pass over the narrow *Groove* in the edge of the *Roller*. This *String* is laid in the *Groove* made on the edge of the *Wheel*, and also in the *Groove* of the *Work*. But before it is laid upon both, one part of the *String* is lapt over and crosses the other, and the *String* receives the Form of a Figure of 8 (only one of its Bows or Circles becomes no bigger than the *Groove* in the *Work*, and the other as big as the *Groove* in the *Wheele*.)

Then the whole Frame wherein the *Wheel* is fixed is removed farther off the *Lathe*, that the *String* may draw tight upon the *Work*.

The reason why the *String* thus crosses it self, is, because it will touch and gird more upon the *Groove* of the *Work*, and consequently (as was said before ¶ 14.) will the better command the *Work* about.

The manner of Turning this *Wheel*, is as the manner of Turning other *Wheels* with *Handles*.

Besides, the commanding Heavy *Work* about, the *Wheel* rids *Work* faster off than the *Pole* can do: because the springing up of the *Pole* makes an intermission in the running about of the *Work*, but with the *Wheel* the *Work* runs always the same way; so that the *Tool* need never be off it, unless it be to examine the *Work* as it is doing.

When the *Wheel* is used, its Edge stands athwart the *Cheeks* of the *Lathe*.

¶ 13. Of the Treddle-Wheel.

THis is a *Wheel* made of a round Board of about two Foot and an half Diameter, conveniently to stand under the *Cheeks* of the *Lathe*. It also hath a *Groove* on its Edge for the *String* to run in; it hath an *Iron Axis* with a *Crook* or *Cranck* at one end: And on this *Crook* is slipt the Noose of a *Leather Thong*, which having its other end fastned to a *Treddle*, does, by keeping exact time in *Treads*, carry it swiftly about without intermission.

But the length of the *Thong* must be so fitted, that when the *Wheel* stands still, and the *Crook* at the end of the *Axis* hangs downwards, the end of the *Treddle* to which the *Thong* is fastned may hang about two or three Inches off the Ground: For then, giving the *Wheel* a small turn with the Hand, till the *Crook* rises to the highest, and passes a little beyond it; if just then (I say) the Workman gives a quick *Tread* upon the *Treddle* to bring the *Crook* down again with a jerk, that *Tread* will set it in a motion for several revolutions; and then if he observes to make his next *Tread* just when the *Crook* comes about again to the same position, it will continue the motion, and cause of the motion, and keep the *Wheel* always running the same way, if he punctually times his *Treads*.

The *Treddle Wheel* is used for small work only, as not having strength enough to carry heavy Work about, such as *Cane-Heads*, *Small Boxes*, &c. and it is fitted below the *Cheeks* between the *Puppets*, as the *Bow* is above.

Besides these Inventions to carry about the Work in the *Lathe*, there are many more; as with a great
Iron

Iron Wheel, having Teeth on its edge, which Teeth are to fall into an *Iron Nut* upon an *Iron Axis*, pitcht upon the *Pikes* of the *Puppets* of the *Lathe*, or fitted into *Collars*, &c.

Also, for very Heavy Work, as Guns, Great Mortars, &c. *Wheels* Turn'd with *Wind*, *Water* or *Horses*, to carry the Work about. Of which more in their proper places.

¶ 14. Of the String.

UPon the thin end of the *Pole* is wound a considerable Bundle of *String*, That as a *Mandrel* requires to be bigger than ordinary, or the Work heavier, they may unwind so much of the *String* as will compass the *Mandrel* twice, or (if the Work be heavy) thrice; the easier to carry it about.

This *String* is made of the Guts of Beasts (most commonly of Sheep, and spun round of several thick-nesses; of which the Workman chuses such sizes as are aptest for his Work, for large and heavy Work very thick, but for small and light work thin: And there are several reasons for his Choice; For a thin *String* will be too weak for heavy Work; but if it were not too weak for heavy work, it would be apt to mark soft wood more than a thick *String* would, when they are forc'd to shift the *String*, and let it run upon the Work. Besides, a thin *String* (though it were strong enough) would not so well bring heavy Work about; because being small, but little of the *String* touches the wood to command it, unless they wind it the oftner about the Work, which both takes up time, and hazards the breaking of the *String*, by the fretting of the several twists against one another.

Now

Now a thick *String* is uncommodious for small work; because having a strength and stubbornness proportionable to its size, it will not comply closely to a piece of Work of small Diameter, but will be apt to slip about it, unless both *Pole* and *Tread* be very strong; and then, if the Center-holes be not very deep, and the *Pikes* fill them not very tight, and the *Puppets* also not very well fixt, the Strength of the *String* will alter the Center-holes; especially, when the work is upon soft Wood, or else it will endanger the breaking the Work in its weakest place.

¶ 15. Of the Seat.

PArallel to the *Cheeks* on the inside the *Lathe* is fitted a *Seat*, about two and an half Inches square, and the whole length of the *Lathe*; having an Iron *Pin* fastned on either end the underside of it: It lies upon two *Bearers* of wood, that are fastned athwart the outer sides the *Legs*, (or else to set it higher) the outer ends of the *Cheeks*, according to the height of the person that works at the *Lathe*. These *Bearers* reach in length so far inwards, as that they may be capable to bear the *Seat* so far off from the *Lathe*, as is the Diameter of the Work they intend to *Turn* in the *Lathe*, and also the bulk of the Workman that stands between the *Lathe* and it, may be contained.

It is not called a *Seat* because it is so; but because the Workman places the upper part of his Buttocks against it, that he may stand the steddier to his Work, and consequently guide his Foot the firmer, and exacter.

The

The two *Bearers* have several Holes made in them, from within sixteen Inches off the *Lathe*, to the ends of them, that the Iron *Pins* fastned in the ends of the *Seat*, may be removed nearer or farther off the *Lathe*, according to the greatness or smallness of the Diameter of their Work.

Having thus described the parts of a Common *Lathe*, I shall now follow with their other Tools also.

§ II. Of Gouges,

Gouges are marked B B in *Plate 15*. They do the Office of *Fore-plains* in *Joynery*, and the *Jack-plains* in *Carpentry*, and serve only to take off the Irregularities the *Hatchet*, or sometimes the *Dram-knife* leaves, after the work is hewed or drawn pretty near a Round with either of them: And therefore as the *Fore-plain* is made with a Corner-edge, only to take off the Irregularities of a Board, so the *Gouge*, that it may also take off the Irregularities or Extuberancies that lie farthest from the *Axis* of the Work, and also frame pretty near the hollow Moldings required in the Work, precede the *Smoothing-Chissels*. And that the *Gouge* may the more commodiously and effectually do it, the Blade of this Tool is formed about half round to an edge, and the two extream ends of this half round a little sloped off towards the middle of it, that a small part about the middle may the easier cut off the prominencies that are not concentrick to the *Axis*, and so bring the Work into a Method of Formation.

The hollow edge is ground upon the Corner of a *Grind-stone*, which in short time wears the out-side of that Corner to comply and form with the hollow

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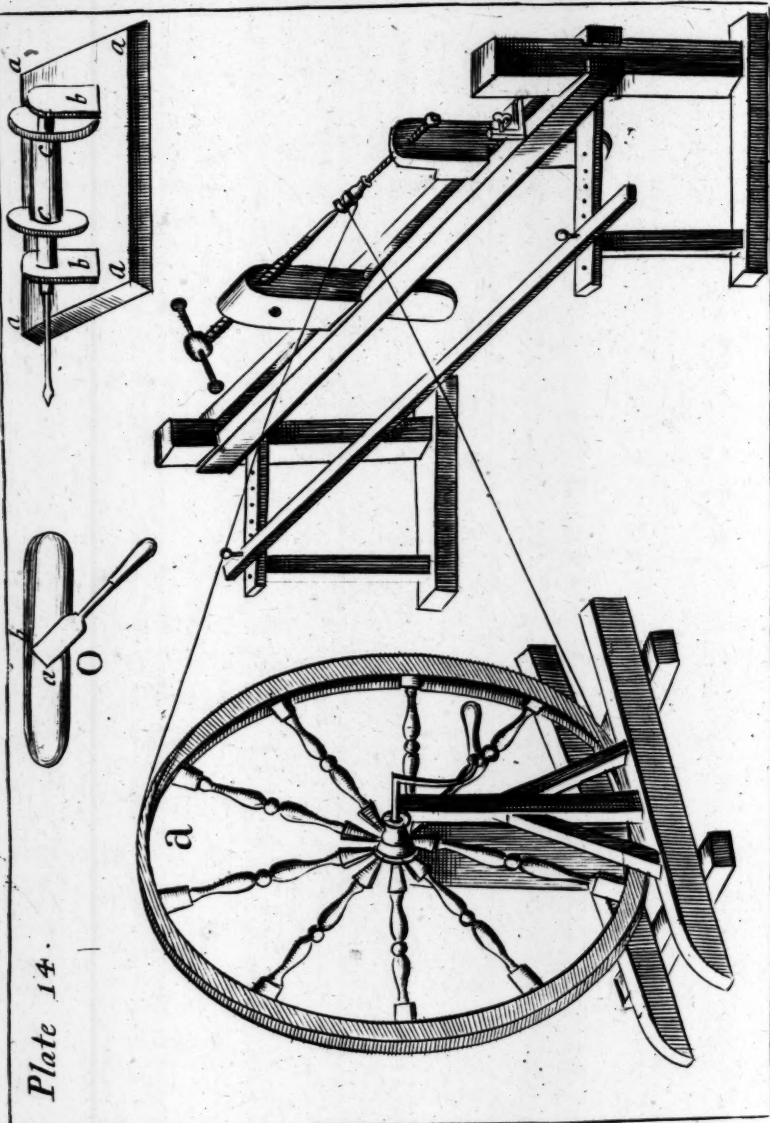
of

of the *Gonge*. It is afterwards Set upon a round *Whetstone*, that fits the hollow of the edge, or is somewhat less. But they do not Set their *Gonges* or *Chissels* as (I told you in *Numb. 4. § 10.*) the *Joyners* do; for *Turners Tools* being somewhat unweldy, by reason of their size, and long *Handles*, they lay the *Blade* of the *Gonge* with its convex side upon the *Rest* of the *Lathe*; and so with the *Whetstone* in their right hand they rub upon the *Basil* the *Grindstone* made, and as they rub, they often turn another part of the hollow of the edge to bear upon the round of the *Whetstone*, till they have with the *Whetstone* taken off the roughness of the *Grindstone*.

Of these *Gonges* there are several sizes, viz. from a quarter of an Inch to an whole Inch, and sometimes for very large Work two Inches over.

The *Handles* to these *Gonges* (and indeed to all other *Turning Tools*) are not made as the *Handles* of *Joyners* or *Carpenters Tools* are, but tapering towards the end, and so long that the *Handle* may reach (when they use it) under the Arm-pit of the Workman, that he may have more stay and steady management of the *Tool*.

Plate 14.



Numb XL
MECHANICK
EXERCISES,

O R

The Doctrine of
Handy-Works.

Applied to the Art of TURNING.

By *Joseph Moxon*, Member of the *Royal Society*, and *Hydrographer* to the
Kings most Excellent Majesty.



LONDON,

Printed for *Joseph Moxon* at the Sign of *Atlas* on *Ludgate-Hill*, 1680.

MECHANICS

EXTRACT

OF

THE

W-Book

APPLIED

TO

THE

ARTS

Printed by J. W. Smith, 1880

MECHANICK EXERCISES,

O R,

The Doctrine of

Handy-works,

Applied to the Art of TURNING.

§ III. Of Flat Chissels.

THE *Flat Chissels* are marked CC in *Plate 15*. These do the office of *Smoothing Plains* in *Joining* and *Carpentry*: for coming after the *Gonges* they cut off the prominent Risings that the *Gonges* leave above the hollow.

The edges of these *Flat Chissels* are not ground to such a *Basil* as the *Joiners Chissels* are, which are made on one of the *Flat sides* of the *Chissels*; But are *Basil'd* away on both the *flat sides*; so that the edge lies between both the sides in the middle of the *Tool*: And therefore either side of the *Tool* may indifferently be applied to the *Work*; which could not well be, should the edge lie on one of the sides of the *Tool*: Because, if they should apply the *Basil* side of the *Tool* to the *Work*, the thickness of the *Basil* would bear the edge of the *Tool* off: And should they apply that side of the

the *Tool* the edge lies on to the *Work*, the swift coming about of the *Work* would (where a small irregularity of *Stuff* should happen) draw or job the sudden edge into the *Stuff*, and so dawke it; which if the *Stuff* be already small enough, would now be too small; because in *Turning*, all Irregularities must be wrought smooth down.

Of those *Flat Chissels* there are several sizes, viz. from a quarter of an Inch, one Inch, two Inches, to three Inches broad, according to the largeness of the *Work*.

These are Set with the *Whetstone* as the *Gouges* are, only they often turn the *Gouges* upon the round side, because they would smoothen all the hollow edge; but these are laid flat upon the *Rest*, and with a flat *Whetstone* rubbed on the *Basls*, as the *Gouge* was with the Round.

§ IV. Of Hooks.

THe *Hook* is marked D in *Plate 15*. As the *Gouge* is used when the *Work* lies before the *Workman*, viz. parallel to its *Axis*, and cuts right forwards, so the *Hook* is used when the *Work* stands on the right or left side the *Workman*, as the flat sides of Boards to be *Turned* do; and therefore this work may be said to lie athwart its *Axis*: and the *Hook* is made so as to cut on the right or left side a Board, and to tak off the extuberancies from the plain of the Board. But though this *Tool* does the Office of a *Gouge*, yet it is more difficult for a *Workman* to use than a *Gouge*; because it is made thinner and slenderer than a *Gouge*, that its Edge cutting at a greater Bearing from the *Rest*, may the easier come at the
Stuff

Stuff it works upon, and the farther the Edge that cuts lies from the *Rest*, the more difficult it is for a Workman to guide it; because it is then more subject to tremble; especially since (as aforesaid) the Edge of the *Hook* is and must be thinner than the Edge of the *Gouge*.

These *Tools*, as also the *Gonges* and *Flat Chissels*, are all about ten or twelve Inches long without the Handles.

The *Hooks* when they want sharpening cannot be ground as the *Gonges* and *Chissels* are; but they must be first softened in the Fire and turned straight, and then brought to an Edge, and by heating again red hot turned into its form: Then must it be hardened and tempered as you were taught *Numb. 3. fol. 57, 58*. Yet do not Workmen proceed thus with their *Hook* every time it grows bluntish, but only when the Edge is either by long use or bad Temper grown so thick, that this following way will not help them: For they *Whet* the outer Edge with a *Whetstone* as they do other *Tools*. But because they cannot come at the inner Edge of the *Hook* with a *Whetstone*, unless the *Hook* be very wide, and the *Whetstone* very thin, they make use of a piece of Temper'd Steel, as sometimes the thin side of a *Chissel*, or the back of a Knife, and so with the Edge of the Square, scrape along the hollow Edge of the *Hook*, and force the Edge as much to the outside of the *Hook* as they can. Thus *Butchers* wear at their Girdles small round Rods of Steel well Tempered and polisht, that they may with quick dispatch whet their Knives upon it, by forcing the Edge forwards upon the Blade, or pressing down the Shoulder that hinders the Edges Entrance: For their Steels being so well polisht, cannot properly be

said to wear away any part of the Shoulder that should hinder the Edge from doing its Office.

§ V. Of Grooving Hooks, and Grooving Tools.

THe *Grooving Hook* is marked E in *Plate 13*, and hath its *Tooth* of different forms, according to the Fashion of the *Groove* to be made on the *Plain* of the Board; For sometimes its *Tooth* hath a Flat Edge, sometimes a round Edge, sometimes a point only, and sometimes two points, or other Forms as aforesaid.

Its whole Blade is made much stronger than the *Gouge* and *Chissels*, and hath the sides of its Edge more obtuse to make it the stronger.

The *Flat Tools* work the Boards Flat either to the Plain of the Board, or to a Flat Groove in the Board.

The *Round Edge* cuts an half round hollow in the Board.

The *Point* cuts a fine Hollow Circle or Swage in the Flat of the Board; and being made Triangular, hath three Edges, each of which cuts the Ridges smooth down that the *Hook* left upon the Board.

The *two Point Grooving Hook* cuts two fine Hollow Circles or Swages on the Plain of the Board.

The *Grooving Hooks* do not work as the *Hooks* do; For the Hooks cut the Wood; but these do but indeed scrape off the Extuberancies, or fret into the Wood; and therefore they are very seldom used to Soft Wood, because its being loose, will not endure scraping without leaving a roughness upon the Work; But Hard Wood or Ivory (for the Reason converted) will.

§ VI. Of Mandrels. And ¶ 1. Of Flat Mandrels.

M *Andrels* are marked F 1. F 2. F 3. F 4. in Plate 15. There are different Sorts of *Mandrels*, and the sizes of them also different, according to the sizes of the Work.

1. *Broad Flat Mandrels* marked F 1. in Plate 15. with three or more little Iron *Pegs* or *Points* near the Verge of its Flat: And these are used for the *Turning* Flat Boards upon. For the backside of a Board placed Flat upon it, will, when screwed up tight between the *Pikes*, by help of the Iron *Pegs*, remain in its place and position, whilst the Flat side of the Work is working upon.

Behind the Backside of this *Mandrel* (and indeed all other *Mandrels*) is fitted a long *Shank* or *Rowler*, for the *String* to be wound about while the Work is *Turning*. This *Rowler* must be so large in Diameter, that the *String* wound about it may command the Work about. If the Work be large and heavy, the *Rowler* must be bigger than if the Work be light; for else the *String* will not command it about: But if the Diameter of the *Rowler* be smaller, the Work comes so much swifter about. The *Rowler* must also be so long between its *Shoulders*, that it may conveniently contain so many Diameters of the *String* as shall be necessary to wind about it.

This whole *Mandrel* is marked F 1. in Plate 15. a The Round Flat or Face of the *Mandrel*. b The *Rowler*. c c The *Shoulders* of the *Rowler*. d d d The *Pegs*.

¶ 2. Of Pin-Mandrels.

2. **M**andrels are made with a long Wooden *Shank*, to fit stiff into a round hole that is made in the Work that is to be *Turned*. This *Mandrel* is called a *Shank* or *Pin-Mandrel*, and is marked F 2. in *Plate 15*. And if the hole the *Shank* is to fit into be very small, and the Work to be fastned on it pretty heavy; then *Turners* fasten a round Iron *Shank* or *Pin* of the size of the Hole it is to be fitted into, and fasten their Work upon it. These *Mandrels* with Iron *Shanks* are used by *Turners* that *Turn* Bobbins or such like Work: Because a Wooden *Shank* to fit the small Hole through the Work would not be strong enough to carry the Work about.

¶ 3. Of Hollow-Mandrels.

3. **T**Here is another sort of *Mandrels* called *Hollow Mandrels*, described F 3. *Plate 15*. It is both a *Hollow-Mandrel*, and also used to *Turn* Hollow Work in it. This *Mandrel* hath but one Center-hole belonging to it, viz. at the *Rowler* End or Neck; but it hath a *Shank*, which supplies the Office of another Center-hole. *a* the *Hollow*, *b* the *Shank* or *Neck*. The *Hollow* is made so wide, that the Work intended to be *Turned* Hollow in it may fit very stiff into it, and so deep that it may contain the intended Work.

When it is used, it is pitcht upon the Center at the farther end of the *Rowler*, and hath its *Shank* put into one of the Holes of the *Joint-Coller* described in *Plate 13*. fig. G. that will best fit it: which Hole standing

ing directly against the *Pike* in the hinder *Puppet*, and receiving the *Shank* into it, guides the *Mandrel* about, as if it were pitch upon two Centers: And the Work being forced stiff into the Hollow of this *Mandrel*, will be carried about with it, exposing the Fore-side of the Work bare and free from the *Joynt-Coller*, and not impeded by *Spikes* from coming at the Work: So that with the *Hook*, *Grooving-Hook*, *Gouge*, or *Flat-Chisel*, according as your Work requires, you may come at it to Turn your intended Form.

Hollow Mandrels are also used in *Collers* that open not with a *Joynt*; But then the *Spindle* is made of Iron, and hath a *Screw* just at its end, upon which is screwed a Block with an Hollow in it, made fit to receive the Work stiff into it.

¶ 4. Of the Screw-Mandrel.

4. **A** Nother sort of *Mandrel* is called the *Screw-Mandrel*, and is marked F 4. in Plate 15. *a* the *Rowler* of the *Mandrel*, *b* the *Shank* or *Screw* is made of Iron, having its two ends Round, and in the middle between the Round ends a Square the length of the *Rowler*, and this Square is fitted stiff into a Square Hole made through the middle of the *Rowler*, that it turn not about in the Square Hole. In each Flat end of this Iron *Shank* or *Spindle* is made a Center-Hole, whereinto the *Pikes* of the *Puppets* are pitcht when this *Mandrel* is used. This Iron *Shank* or *Axis* must be made very straight, and ought to be turned upon the two Center-Holes, for exactness; Because on one of the Round ends, or sometimes on both, a *Screw*, or indeed several *Screws* of several Diameters is made. That *Screw* next the end of the

Shank is the smallest, viz. about three quarters of an Inch over, and takes up in length towards the middle of the *Shank*, about an Inch, or an Inch and an half; and so far from the end of the *Shank* it is of an equal Diameter all the way: And on this portion of the *Shank* is made a *Male-screw* of the finest Thread. The next Inch and half (wrought as before) hath another *Male-screw*; but about half a quarter of an Inch more in Diameter than the former, and hath its Threads courser. Another Inch and half hath its Diameter still greater, and its Threads yet courser. And thus you may make the *Shank* as long as you will, that you may have the more Variety of Sizes for *Screws*.

These sorts of *Mandrels* are made for the making of *Screws* to *Boxes*, and their *Lids*, as shall be shewed in the next Paragraph.

¶ 5. Of Sockets or Chocks belonging to the Screw-Mandrel.

TO this *Screw-Mandrel* belongs so many *Sockets* as there are several sizes of *Screws* on the *Shank*. They are marked F 5 in *Plate 15*. *a* the *Socket* or *Chock*; *b b* the *Wooden Pin*. *c* the *Stay*. *d d* the *Notch* to slip over the *Male-screw*.

These *Hollow Sockets* have *Female Screws* in them made before the *Notch* to slip over the *Male-screw* of the *Screw-Mandrel* is cut. The manner of making *Female-screws* is taught *Numb. 2. fol. 29, 30, 31*. only instead of a *Tap* (used there) you use the several and different sizes of *Screws*, made on the *Screw-Mandrel* to do the Office of a *Tap* into each respective *Socket*; which *Sockets* being only made of *Hard Wood*, it will easily perform, though the *Shank* or *Axis* be but *Iron*.

There-

Therefore (as aforesaid) to each of the *Male-screws* on the *Screw-Mandrel* is fitted such a *Socket*, that you may chuse a *Thread* Courser or *Finer* as you please: But this *Female-screw* is open, or hath a *Notch* on one side of it, that it may slip over the *Male-screw*, and the *Threads* of each other fit into each others *Grooves*; and when they are thus fitted to one another, the further or open side of the *Male-screw* is gaged in, or pin'd on the *Female-screw* with a *Wooden Pin* thrust through two opposite *Holes*, made for that purpose in the *Cheeks* of the *Wooden Sockets*, that it shake not.

When the *Treadle* comes down in working, and the *Socket* is fitted on its proper *Screw*, and pinn'd stiff upon it, and the *Stay* held down to the *Rest* of the *Lathe*, then will the *Socket*, and consequently the *Stay* slide forwards upon the *Male-screws*; so that a *Tool* held steddly on any part of the *Stay*, and applied to the out or inside of your *Work*; that *Tools* point will describe and cut a *Screw*, whose *Thread* shall be of the same fineness that the *Screw* and the *Shank* is of.

S. VII. Of Collers.

There are several fashion'd *Collers*: As the *Joynt-Coller* marked G, the *Round Coller* marked H, and the *Coller* marked I, in *Plate 13*.

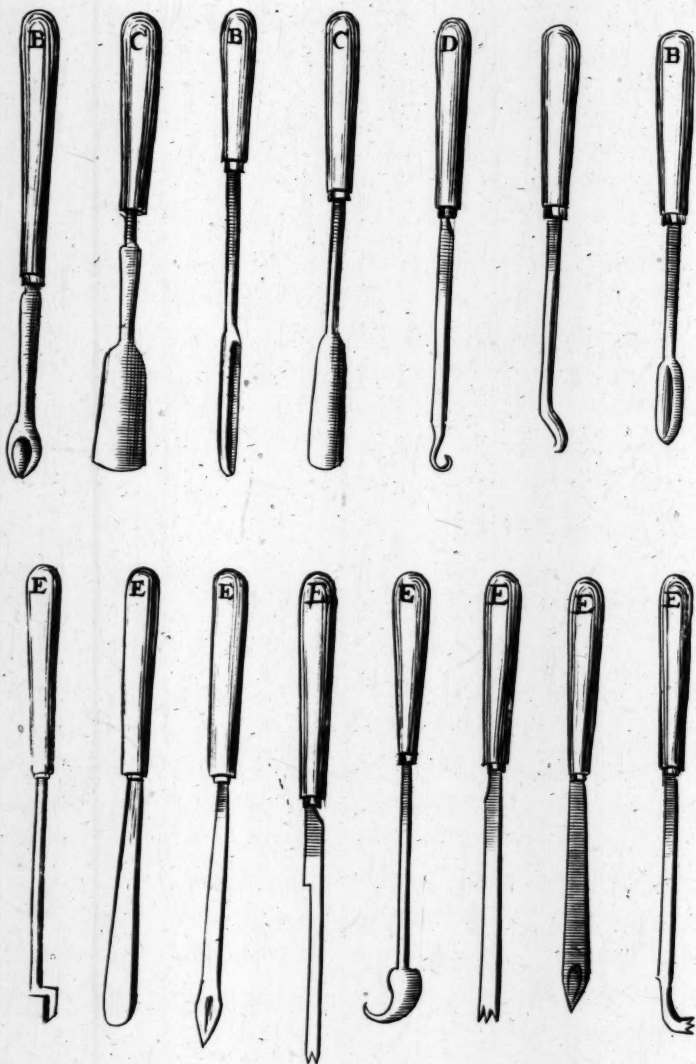
The *Joynt-Coller* is made of two *Iron Cheeks* marked *b b*, which moving upon a *Joynt c* at the *Bottom*, may be set close together, or else opened as the two insides of the *Joynt-Rule Carpenters* use do. On the the *Inner Edge* of each *Cheek* is formed as many half-round *Holes* or *Semi-circles* as you please, or the length of the *Cheeks* will conveniently admit: These *Semi-circles*

circles are made of different Diameters, that they may fit the *Shanks* or *Necks* of different siz'd *Mandrels*: And these Semi-Circles must be made so exactly against each other on the edges of the *Cheeks*, that when the two *Cheeks* moving upon their *Joynt* are clapt close together, the Semi-Circles on both the *Cheeks* shall become a perfect round hole or Circumference.

Near the top of one of these *Cheeks* is fastned with a *Center-pin*, a Square Iron *Coller* marked *d*, with a small *Handle* to it marked *e*. This square *Coller* is made to contain the breadth of both the *Cheeks* when they are shut together, and to hold them so fast together, that they shall not start assunder; and yet is made so fit, that it may slip off and on both the *Cheeks*.

This *Joynt-Coller* may serve to do the office of the other two *Collers*, and its own particular Office too: yet to save the Charge of the price of this *Tool*, *Turners* seldom use them, but make shift with either of the other; or sometimes with a Hole made in a Board only: But its particular Office is to hold a *Mandrel*, whose *Neck* is fitted to one of its *Holes*, and the Work they are to *Turn* is required to stand out free from the outer Flat of the *Cheeks* of the *Coller*, the better to come at it with the *Tool*: such as are deep *Boxes*, or deep *Cups*, &c.

Plate 15.



Numb. XII.
MECHANICK
EXERCISES,
OR
The Doctrine of
Handy-Works.

Applied to the Art of *T U R N I N G*.

By *Joseph Moxon*, Member of the *Royal Society*, and *Hydrographer* to the
Kings most Excellent Majesty.



LONDON,

Printed for *Joseph Moxon* at the Sign of *Atlas* on *Ludgate-Hill*, 1680.

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MECHANICK EXERCISES,
 O R,
 The Doctrine of
Handy-works,
 Applied to the Art of **TURNING.**

s VIII. *Of the Mawl.*

THE *Mawl* is marked K in *Plate 13.* The Figure of it there is Description sufficient: Its Office is to knock and unknock the *Wedge* in the *Puppets*: and to knock upon the back of the *Cleaving Knife*, when they split their Wood for their Work. The *Joyners Mallet* would supply the Office of this Tool; but Use has made the *Mawl* more handy for them: Besides when one is batter'd to shivers, they can quickly of a Chump o Wood accommodate themselves with another.

s IX. *Of the Hatchet, Draw-knife, and Cleaving-Knife.*

THE *Hatchet* is marked L in *Plate 4.* It is of the same sort that *Joyners* use; which I described *Num. 5. s 25.* and therefore refer you thither.

F f

And

And the *Draw-knife* is described in *Numb. 7. § 5. Plate 8.* marked E. The *Cleaving-knife* marked M in *Plate 13.* needs no other Description than that Figure.

§ X. Of the Chopping-Block.

THE *Chopping-Block* is marked N in *Plate 13.* It is made of a piece of *Elm-Tree* placed with its Grain upwards and downwards as it grew. It hath three Legs in it, that stand stradling out from the under-side of the *Block* to the Floor, and of such an height, as the *Workman* may have most Command of the Work. See the Figure. Sometimes *Turners* use instead of it a piece of the Trunk of a Tree of about a Foot and an half or two Foot in length from the Ground, or more or less.

§ XI. Of the Callipers.

THE *Callipers* is marked O in *Plate 13.* As common *Compasses* (described *Numb. 6. § 32.*) are for measuring Distances upon a plain Superficies; so *Callipers* measure the distance of any round *Cylindrick* Conical Body, either in their Extremity, or any part less than the Extream: So that when *Workmen* use them, they open the two points *a a* to their described width, and Turn so much Stuff off the intended place, till the two points of the *Callipers* fit just over their Work; so shall their Work have just the Diameter in that place, as is the distance between the two points of the *Callipers*, be it either Feet or Inches, &c.

§ XII. Of the Drill-Bench.

There is yet another *Tool*, or rather a *Machine* used by some *Turners*, called a *Drill-Bench*. It is described in *Plate 14.* *a a a a* a thick Board, about three Inches thick, five Inches broad, and eighteen Inches long. *b b* two *Stiles* placed towards either end, and fastned upright. In the hithermost *Stile* is a *Coller* described § 7. and *Plate 13.* H, or any of the other *Collers*: And in the further *Stile* is fitted a square flat tempered piece of Steel having a Center-hole in the middle of it, and is placed just against the Center or middle point of the Hole of the *Coller*. *c c* the *Rowler* whose hither end is Turned away, so as it just fit into the *Coller*, and at the further end of it, it hath a temper'd Steel *Pin*, to be placed in the Center-hole: And in the middle of the hither end of it, it hath a *Piercer-Bit* fastened straight in, so that it lie in a true straight Line, with the *Axis* of the *Rowler*. Of these *Rowlers* they have several, and *Bits* of different sizes fitted into them, that upon all occasions they may chuse one to fit their purpose.

On the under-side, about the middle of the *Bench*, is fitted and fastned athwart it a square Iron *Coller*, deep enough to reach through the *Cheeks* of the *Lathe*, and so much deeper as it may receive a Wooden *Wedge*, such a one as belongs to one of the *Puppets*: And by the force and strength of the *Wedge* the whole *Drill-bench* is drawn down, and fastned athwart the *Cheeks* of the *Lathe*.

When it is used, it stands athwart the *Cheeks* of the *Lathe* (as aforesaid) with the point or end of the *Bit* towards you; and then the *String* being turned twice

or thrice about the *Rowler*, will (with *Treading* on the *Treddle*) turn the *Rowler* and its *Bit* forcibly about, and cause it enter swiftly into a piece of Wood that shall be prest forwards upon the *Bit*.

When they use it, they hold the piece of Wood they intend to *Drill* or *Pierce* fast in both their Hands, right before them, and prest it forwards upon the *Piercer Bit*; so that by its running about, it cuts a streight round hole into the Wood of what length they please.

But while the *Pole* is rising after every *Tread*, they prest not against the *Piercer-Bit*, so that it is dis-engaged from doing its Office in the Wood; but in that while, they nimbly give the Wood a turn in their hands, of about one third part of its Circumference; which makes the *Bit* every successive *Tread*, go the straighter through the middle of the Wood: And thus they reiterate *Treads* and keep the Wood turning in their Hands, till the *Bit* is enter'd deep enough.

Thus much for the *Tools* used in common *Turning*: I shall proceed to the working a Pattern or two in in Soft Wood; which being well understood, may render a Practicer capable of most Common Work.

§ XIII. Of Turning a Cilinder in Soft Wood.

THE Soft Wood Turners Use is commonly either *Maple*, *Alder*, *Birch*, *Beech*, *Elm*, *Oak*, *Fir*, &c. and for some particular purposes each of these sorts are best.

The First Patern we purpose, shall be a *Cilinder* two Inches over, and eight Inches long: Therefore you must chuse a piece of Wood at least two Inches and a quarter over, lest you want Stuff to work upon: Nay, if your Stuff prove shaken or otherwise unsound,

unfound, or your Centers be not very exactly pitcht, you may want yet more Stuff; and that according as it proves more or less faulty, or as the Centers are more unequally pitcht. But supposing the Stuff good, you may take a piece of two Inches and a quarter over, as I said before, and about ten or eleven Inches long: For though the length of the *Cylinder* be but eight Inches, yet you must cut your Stuff long enough to make a Groove at one end of it besides, for the *String* to run in. If your Stuff be somewhat too big for your Scantlin, and not round enough to go into the *Lathe*, you must *Hew* it pretty near with the *Hatchet* to make it sizable, and afterwards smoothen it nearer with a *Draw-knife*, as you were taught *Numb. 7. § 5.*

But if you have not Stuff at hand near your size, then you must Saw off your length from a Billet, or some other piece of Stuff, and with the *Cleaving-knife* and the *Mawl*, split it into a square piece near the size, and with the *Draw-knife* round off the Edges, to make it fit for the *Lathe*.

Then set your *Puppets*, and wedge them tight up, so as the *Points* of your *Spikes* stand pretty near the length of your Work assunder, and move the *Pole*, so as the end of it may hang over between the *Pikes*, and also fit the *Iron Pin* in the *Treddle* into a proper *Hole* in the *Cross-Treddle*, so as the end of the *Treddle* may draw the *String* below the Work into pretty near a straight Line with the *String* above the Work: And take the Work in your Right hand, and put it beyond the *String* before you, and with your left hand wind the *String* below the Work but once about the Work, lest it should be too strong for your shallow Centers, as you shall understand by and by,

and then with a pretty strength press the middle of one end of your Work over the Point of one of the *Pikes*, and so make a hole in your Work for one of the Center-holes: Then screw your *Pike* wider or closer according as the length of your Work requires, and pitch the other end of your Work upon the other *Pike* also, and screw your Work a little lightly up: Then try how the Centers are pitcht, by Treading the *Treddle* lightly down; and if you find the Centers are well pitcht, you may without more ado screw up your Work tight: But if your Centers, or either of them be not well pitcht, you must alter them. You may know when they are well pitcht, by treading softly upon your *Treddle*, and holding your Finger steady on the *Rest*, direct the point of it pretty close to the Work: For if in a Revolution of your Work, its Outside keeps at an equal distance from the end of your Finger, you may conclude your Work is well pitcht. But if you find one side of your Work comes nearer your Finger than the other side, you must with your *Flat Chissel* or *Gonge*, (or what is nearest at hand) knock softly, or hard, upon that side that comes nearest to your Finger, till you have forc'd the *Pikes* into the true Centers at the end of your Work; and then you may boldly screw it hard up: But you must be sure to screw it hard up; because it is Soft Wood you purpose to work upon, and the strength of the *Pole* may endanger the drawing or removing the Centers, if the *Pikes* have not good hold of them.

Having found your Centers, take your Work again off the *Pikes*, and wind the *String* once or twice more about your Work, that your *String* (as I said in Numb. 10. § 1. when I wrote of the *String*) may the better command it, and then wind off or on more
String

String at the end of your *Pole*, or end of your *Treddle*, or both, if your Work require it, till the *Pole* draws the *Treddle* up a little above half the length of the *Legs* of the *Lathe*: For about that height your Leg may without suddain tiring command the *Pole* down again.

But before you begin to work upon the Stuff, I shall inform you how to *Tread* the *Treddle*; In which you may observe this General Rule; That the nearer the Fore-end of the *Treddle* you *Tread*, the easier you bring down the *Pole*; But then the *Pole* in its Spring raises your Leg the higher, and may draw the upper side of your Thigh against the under side of the *Cheek* of the *Lathe*, and with reiterated Rifings Gawl and also tyre your Thigh.

Place therefore your Foot steddy upon the *Treddle*, so far forward as you can to avoid the *Poles* Rising from drawing your Thigh against the under side of the *Lathe*; and Tread the *Treddle* nimbly down, but not quite so low as to knock against the Floor: Then abate the weight of your Tread, and let the *Pole* draw the *Treddle* up; but still keep your Foot steddy, and lightly Bearing upon the *Treddle*: For then your succeeding *Treads* will prove easier to your Leg and Thigh, and you will with your Foot the better and quicker command the *Treddle*. Then *Tread* again nimbly down as before, and keep this Train of Treading till your Work be finish'd, or that you may have occasion to stop and examine how rightly you proceed:

In all small Work the *Tread* is lightly and nimbly performed; but in large and heavy Work the *Tread* comes slow and heavily down.

This

This being premised, you may begin with your *Gonge*: Lay the Round side of it upon the *Rest*, and take the *Handle* of it in your *Right hand*, and lay the *Fore* and *Middle Fingers* of your *Left Hand* upon the *Hollow* of the *Gonge* near the *Work*, mounting the *Edge* about a quarter of an *Inch* above the *Axis* of your *Work*, and sinking your *Right hand* a little: for in this position the *Gonge* cuts best: And thus cut down on your *Work* near one end a *Groove* for your *String* to run in: The *Groove* may be about an *Inch*, or an *Inch* and an *half* long: But it matters not much what *depth*. Then slip your *String* into the *Groove*, and if you find the *String* will not slip easily, you may put your *Foot* under the *Treddie*, and lift it a little up, that the *String* when no weight is hanged to it, may slide the easier into the *Groove*.

And by the way you may take notice, that the deeper you cut down the *Groove*, the oftner will your *Work* come about every *Tread*; because the *String* that comes down every *Tread*, measures a small *Circumference* oftner than it does a greater *Circumference*: But then the *Work* is not so strongly carried about; because it hath a less portion of the *String* to command it. This I hint, not that in this our small proposed *Pattern* it is very considerable: For if you only cut the *Groove* down but so low as there may be a *Shoulder* at the end, and another against the *Work*, to keep the *String* from slipping out of the *Groove*, it will be sufficient: But in *Heavy Work* this *Groove* ought to be cut with discretion.

Now come to the *Forming* of your *Work*, and hold your *Gonge* as you were taught before, but somewhat lightly against your *Work*, beginning at one end, and sliding your *Gonge* gradually to the other, cutting
with

with its Edge all the way you go, and bearing somewhat stiff against the Work every Tread you make on the *Treddle*: And withdrawing it again a little lightly from the *Work* every Spring of the *Pole*. And thus by Use you must habituate your self to let the Edge of your *Tool* bear upon the Work when the *Pole* and *Treddle* comes down, and to draw it back just off the Work, as the *Pole* and *Treddle* goes up. And thus you must continue till you have rough-wrought all your Work from end to end.

If you have not at first brought your Work clean; that is, if you have not gone deep enough with your *Gonge* to take off all the Risings of the Stuff the *Draw-knife* left, even with the smallest part of your Work, you must in like manner (as before) work it over again. But you must have a special Care you take not too much Stuff away on any part of the Whole Work: For this proposed Pattern being a *Cilinder*; if you take but a small matter too much away from any part, and make it smaller than your given measure there, the whole Work will be spoiled; as being smaller than the proposed Diameter: Which to know, you may by opening the Points of your *Callipers* to two Inches on your *Rule* (the proposed Diameter of your *Cilinder*) try if the Points at that distance will just slip over the deepest *Grooves* of your Work (for we will not suppose that the *Grooves* are of an equal depth with the Rough-working of the *Gonge*) without straining the Joynt: For then your Work is just fizable: If not work over again as before, &c. But we will now suppose you have not taken too much away, but have made a due process with your *Gonge*. Therefore now proceed and use a *Flat Chissel*, about an Inch and an half broad,

to take off the Irregularities the *Gonge* left.

Take the Handle of it in your Right Hand as you did the *Gonge*, and clasping the *Blade* of it in your Left Hand, lean it steady upon the *Rest*, holding the *Edge* a little asslant over the Work, so as a Corner of the thin side of the *Chissel* may bear upon the *Rest*, and that the Flat side of the *Chissel* may make a small Angle with the *Rest*, and consequently with the Work; (which is parallel to the *Rest*) for should you set the edge of the *Chissel* parallel to the Work, it might run too fast into the Work, and dawd it. Therefore you must set the *Chissel* in such a position that the lower Corner, or near the lower Corner of the edge may cut lightly upon the Work: But this position is best described by a Figure, which to that purpose I have inserted in Plate 14. at O, where you may perceive in or near what position the *Chissel* must be set to cut the Work; and how the edge of the *Chissel* *a b* lying asslant the Work, and the further Corner of the edge of the *Chissel* *b* being somewhat mounted, as the Work comes about, the Bottom or near the Bottom of the edge of the *Chissel* is only capable to cut a narrow Shaving off of the Work: and just in this manner you must keep the *Chissel* steady bearing upon the Work, as the *Pole* comes down, and withdrawing it from the Work as the *Pole* Springs up (as you were taught to use the *Gonge*) and at the same time sliding it forwards from one end of the Work to the other, till it be wrought down all the way to its true Diameter between the points of the *Callipers*: For then a straight *Ruler* applied to your Work, the outside of your proposed *Cylinder* will be formed.

Only

Only the ends must be cut down square to the length: Therefore open the points of your Compasses to the distance of eight Inches on your *Rule*, and prick that distance hard off upon your Work, that the points of your *Compasses* may leave visible marks, by placing one point as near one end as you can, to leave Stuff enough to cut straight down all the way; that is, to cut it square down at right Angles with the outside of the Work. Which to do, you must hold the Handle of the *Flat Chissel* in your Right hand (as before) and clasp the Blade of it in your Left, and lay one of the thin sides of it upon the *Rest*, so that the edge may stand upright, or very near upright against the Work. Then sink your Right hand somewhat below the Level of the *Rest*, that the lower Corner of the edge of the *Chissel* may mount, and being thrust steddy against the Work just in the mark one Point of the *Compasses* made, Tread the *Treadle*, and cut a pretty deep Circle into the Stuff. But you must have a care you do not direct the cutting Corner of the *Chissel* inwards, but rather outwards, lest you make the end hollow instead of Flat: For if you do take off too little at first, you may by degrees cut it down to a Flat afterwards. As you cut deeper into the Stuff, you must turn the Flat of the *Chissel*, and with it cut down the Shoulder just at the end on the out side the mark, for else that may hinder the Corner of the Edge of the *Chissel* for coming at the Work.

Note, that if you hold not the edge of the *Chissel* truly before the Work, but direct it inwards, and if you hold it not very steddy, and have a good guidance of it, the quick coming about of the Work may draw the edge of the *Chissel* into it inwards,

and run a-dawke on the *Cylinder*, like the Groove of a Screw; and so spoil your Work: For being once wrought to the true size, you cannot afterwards take any more off to cleanse it, &c.

The other end must be cut down as this.

§ 14. Of Turning Flat Boards.

IF your Board be thick enough, you may boar a round Hole in the middle of it; and Turn a *Mandrel* with a *Pin* a very little Tapering, to fit hard and stiff into the round Hole: And if the *Hole* and *Pin* be proportionable in size to the weight of the Board, the *Pin* will carry it about. But you must be very careful the *Hole* be boared exactly straight through the middle, and not inclining on either side the Board more to any part of the Verge than to another; but that the middle of the *Hole* be exactly the Center of the Board the whole thickness though. This *Pin-Mandrel* is described Numb. 11. § 6. and Plate 13.

If your Board be not thick enough to be fastned upon a *Pin-Mandrel*, or that your Work will not admit of an Hole to be bored through the middle of it, you may use the *Flat Mandrel* described Plate 13. F 2. And then you must with your *Compasses* find the Center on the backside of the Round Board (with several proffers if need require) till you have found it, and prick there an Hole for a mark: Then open the points of your *Compasses* to about the thickness of a Shilling wider than the Semidiameter of the *Flat Mandrel*; and with the points of your *Compasses* at that distance describe a Circle on the backside of the Board to be Turned, by placing one Foot in the

the prickt mark, and turning about the other Foot. By this Circle you may pitch the Center of the Board exactly upon the Center of the *Flat Mandrel*: For the points of the *Compasses* being opened about the thickness of a Shilling wider than the Semidiameter of the *Flat Mandrel* will (when you have pitcht the Center of the Board on the Center of the *Mandrel*) place the outer Verge of the *Mandrel* the thickness of a Shilling round about within the Circle described on the backside of the Board: And when it is thus pitcht, you may by laying the Board flat down knock upon the *Rowler* end of the *Mandrel*, and drive the *Pegs* in the flat of the *Mandrel* into the Board, and so hold it steddy upon the *Mandrel*: Then find the Center on the Foreside of the Board also, as you were taught to find the Center on the backside, and put your Board and *Mandrel* upon the *Pikes* of the *Puppets*, and screw them hard up, as you have been taught before.

Sometimes *Turners* use this *Flat Mandrel* without *Pegs*, and then they chalk the Flat side of it very well, and clap the backside of the Board to it, which will (if the Board to be *Turned* be not too heavy, but be well screwed up between the *Pikes*) keep the Board steddy from slipping from its set-position, till you work it.

If in going about of your Work you find it *Wabble*, that is, that one side of the Flat incline either to the Right or Left Hand, you must with soft Blows of an Hammer or other Tool at hand set it to right, and then again screw it hard up: For so often as you thus strike upon the Verge to set the Board true, you force the Steel point of the *Pike* more or less (according to the softness of the Wood)

towards that side of the Verge you strike upon; and therefore you may perceive a reason for screwing up the Pike so oft as you knock upon the outer Verge of the Board.

But we will now suppose the Board well pitch and fastned on the *Mandrel* and Center; Therefore take the *Side-Rest* described in § 1. *Numb.* 10. ¶ 7. and *Plate* 13. at the Figure e, and f g, and fit it so into the *Lathe* as the upper edge of it may stand range, or parallel to the side of the Board you are to work upon; and so wedge it hard up.

Now you must come to use the *Hook*, described *Numb* 12. § 5. and *Plate* 15 : For this Tool is most commodious to serve you instead of the *Gouge*, when the Work stands athwart the *Pikes*; because the end of the Blade of this Tool being on its Flat side turned into a Circular Figure, and that Circular Figure turned a little backwards, one of the Edges of this Circular Figure will conveniently (though the Tool be not held straight before the Work) come at any part of the Flat of the Board, and so by the Circulation of the Board against the Edge of the *Hook* cut off its irregular Extuberances.

In the using of this Tool, you must place the end of the *Handle* under your Arm-pit, and hold your left hand on the upper side of the Blade of the Tool close to the *Rest*, and your Right hand close besides your Left Hand under the Tool, and with both your hands clasp the Tool hard, and press it steddly upon the *Rest*, and at the same time hold it also steddly, and yet lightly bearing against the Work, that by the swift coming about of the Work it draw not the Edge of the thin and tender Blade of the *Hook* into it.

You

You must not hold the Blade of this Tool perpendicularly before the Work, *viz.* parallel to the Pikes, but assant, so as somewhat about the middle of the Convex of the *Hook* may touch against the Work. You may begin at the Verge, and so lay several Grooves close by one another till you come to the Center: But you must observe (as was said before in the *Cylinder*) that you lay all your *Grooves* of an equal depth into the Board: For if you lay one deeper than the rest, and an Hollow may not properly be in that place, you must again go over your work with your *Hook*, to work that dark out: And then perhaps your Board may be made too thin for its intended purpose. But this Craft of the Hand must be acquired with some continued Use and Practice, which will better inform your Judgment what Errours you may be subject to commit, than many words (though significant) upon this Doctrine. And this I'm sure I found, when I first practised upon *Turning*.

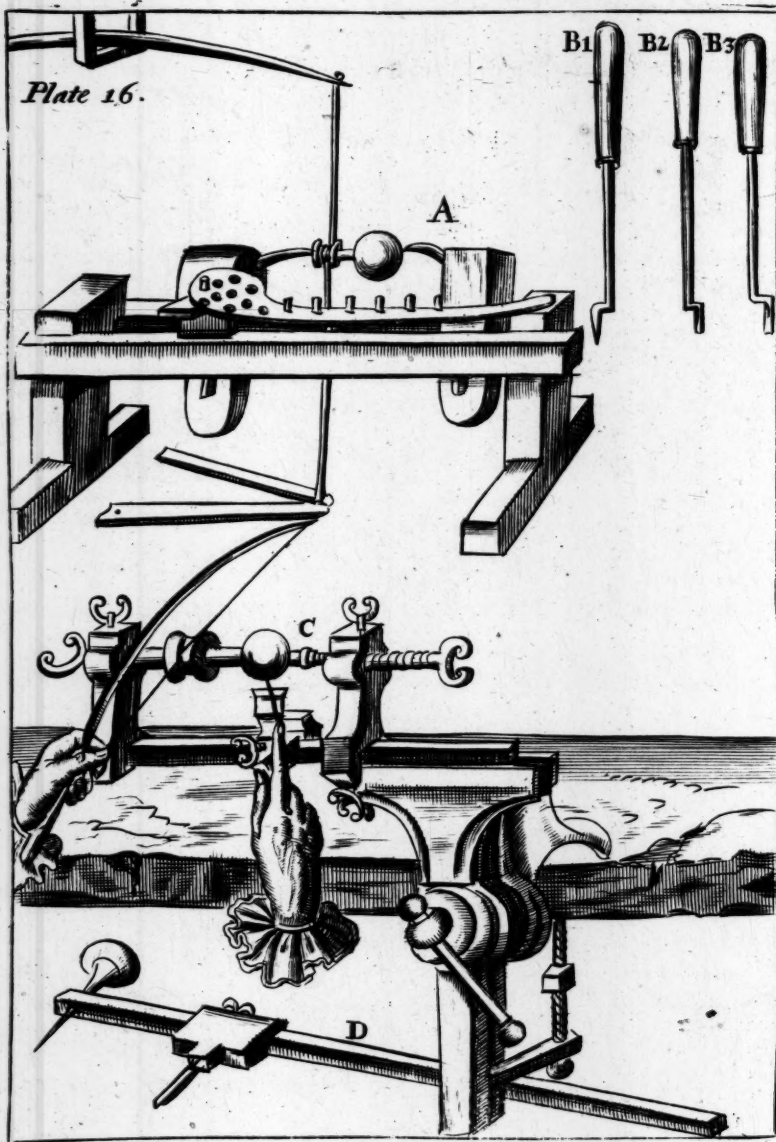
Having thus with the *Hook* rough-plain'd the Board (for this *Hook* does in *Turning* the Office of a *Fore-plain* in *Joynery*) you must use the *Triangular Grooving Tool*, described Numb. II. § 5. Plate 15. and with one of its Edges smoothen down the ridges the *Hook* left on the Board.

But if your Work require any Molding near the Verge or any other part of it, you must work that Molding as near as you can with the *Hook*, especially where Hollows are requir'd; for that cuts faster and smother than any other Tool, and most artificially forms an Hollow.

If a Flat be to be laid in the Board, you must first use the *Triangular Point Tool*, and with it strike

strike so many Threds as the breadth of the Flat requires, and lay each Thred almost so deep into the Board as you intend the Flat shall be : And afterwards to smoothen it down, you must use the *Flat Grooving Tool*, or a *Flat Chissel*, and with either of them finish the Flat to its intended Depth and Breadth. And where a fine Thread or Circle is to be laid in the Board, you must use the *Triangular Point Tool*. And thus as you see occasion, you must accommodate your self with a Tool apt and proper for your purpose *viz.* such a Tool as will most conveniently come at, and form the intended Work.

Plate 16.



Numb. XIII.
MECHANICK
EXERCISES,
OR
The Doctrine of
Handy-Works.

Applied to the Art of *T U R N I N G*.

By *Joseph Moxon*, Member of the *Royal Society*, and *Hydrographer* to the
Kings most Excellent Majesty.



LONDON,

Printed for *Joseph Moxon* at the Sign of *Atlas* on *Ludgate-Hill*, 1680.

PLATE XIII

MECHANICAL

EXPERIMENTAL

11-11

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11-11

11-11

MECHANICK EXERCISES,

O R,

The Doctrine of

Handy-works,

Applied to the Art of TURNING.

§ XV. Of Turning Hard Wood, and Ivory.

IF the Wood be very hard, as *Ebony*, *Lignum Vitæ*; or if it be *Ivory*, *Bone* or *Horn* they are to Turn; they neither use the same Tools they do for Soft Wood; because their edge is too tender: nor do they use their other Tools as they do soft Wood, For the Tools made for Hard Wood are made with a stronger Point, edge, &c. than they are for Soft, as was said Numb. 11. § 5. And they use them differently; because for Turning Soft Wood they hold the Edge of the *Gouge* and *Flat Chissel* at some considerable Distance from the *Rest*, mounting the Edge at such an Angle as will best cut off from the Work as great a Chip as they can, or desire. And as they Turn the Work smaller, they guide the *Chissel* to follow the Work: But for Hard Wood they raise the *Rest* near the Horizontal Plain of the *Axis* of the Work, setting it as close as conveniently they can to their Work, and lay their Tool flat and steadily upon the *Rest*; which being hard held in this position,

H h

fitiōn, does by the coming about of the Work, cut or tear off all the Extuberances the Tool touches in the sweep of the Work. So that (as I said before) as in *Turning* Soft Wood the Tool does somewhat follow the Work; in *Turning* Hard Wood the Work comes to the Tool: And therefore you may perceive a great reason they have to keep the Tool steady: For should it in one sweep of the Work be thrust nearer the *Axis* in any place, it would there take off more than it should.

Having prepared the Work fit for the *Lathe*, either with *Hewing* (as hath been shown *Numb. 5. § 7.* and *Numb. 11. § 13.*) or, as some Hard Woods and Ivory may require, with *Rasping*, they pitch it between the *Pikes*, as before has been shown, or such Work as it may be, as Boxes, and generally all Hollow Work, they fit into *Collers*, either by screwing the *Mandrel* on an Iron *Axis*; or fitting it with some other of the *Mandrels* described *Numb. 11. § 6.* as is proper for it: As sometimes they fit the Work tight into an *Hollow Mandrel*, and the tight fitting in holds it whilst it is working upon: And sometimes, if the Work be very thin, they fix it on a *Flat Mandrel* with *Cement*; But they are always either to chuse one of the *Mandrels* described already in *Numb. 11. § 6.* or else contrive (as they often do) some other *Mandrel* convenient to the opportunity that accidentally, their Business may require. For the Work (whether it be pitcht on the *Pikes*, or fitted into *Hollow Mandrels*, or otherwise) must run very steady and tight about.

But having thus fitted it into the *Lathe*, they begin to work with the *Sharp-pointed Grooving Tool*, or else with the *Triangular Grooving Tool*, and with the point of

of either of these *Tools* break the Grain of the Wood, by laying small Grooves upon its Surface, till they have pretty well wrought away the Extuberances, and brought the Work tollerably near an intended shape, by streightning, hollowing, and leaving Rissings in their several proper places.

Afterwards with Edg'd *Grooving Tools* of a proper Breadth, they cut down and smoothen away the Extuberances left by the *Sharp-pointed Grooving Tool*, or the *Triangular Grooving Tool*, and bring the Work into a perfect shape. Which done, they smoothen the work with the Edge of a piece of a Blade of a broken Knife, basil'd away, by following the Work with it: That is, holding the basil'd Edge of the Knife close against the Work while it comes about: For then its sharp Edge scrapes or shaves off the little roughness the grosser *Tools* left upon the Work.

Lastly, they hold either a piece of Seal Skin or Dutch Reeds (whose outer Skin or Filme somewhat finely cuts) pretty hard against the Work, and so make it smooth enough to polish.

Hard Wood they polish with *Bees Wax*, viz. by holding *Bees Wax* against it, till it have sufficiently toucht it all over; and press it hard into it by holding hard the edge of a Flat piece of hard Wood made fizable and suitable to the Work they work upon, as the Work is going about. Then they set a Gloss on it with a very dry Woollen Rag, lightly smear'd with *Sallad Oyl*.

But *Ivory* they polish with Chalk and Water, and afterwards dry it with a Woollen Rag, and a light touch of *Sallad Oyl*; which at last they rub off again with a dry Woollen Rag, and so set a Gloss on it.

If there be a Screw to be made upon the thin Edge of an *Ivory*, or *Hard Wood*, or *Brass Box*, they use the *Screw Mandrel*, and its *Socket*, described *Numb. 11. § 6. ¶ 4* and *5.* as is shewn at the latter end of that Section.

§ XVI. Of Turning long and slender Work of *Ivory*.

SOME *Turners* to shew their Dexterity in *Turning*, and make others that know not the way how it is done admire at their Skill, *Turn* long and slender Sprigs of *Ivory* as small as an *Hay-stalk*, and perhaps a Foot or more long: which to perform they cut a piece of *Ivory* to its intended length; but strong enough to bear working till they bring it to as small a *Cylinder* as they can; which being thus forwarded, they place a *Joynt Coller* (as is described *Numb. 11. § 7.*) made small and fit for their purpose, just in the middle of their Work: only that their Work may *Bear* at a smaller length, and consequently be stronger for being thus supported while it is *Turned* yet smaller. Then they place other *Collers* between the *Pikes* and the middle *Coller*, and *Turn* the whole *Cylinder* slenderer yet. And thus by placing *Collers* where ever they find the Work buckle, they (as aforesaid) with *Sharp Tools*, tender touches, somewhat a loose and fine *String*, weak Bow, and great care and diligence work the whole *Cylinder* down as small as they list, either with *Moldings* or other Work upon it, as best likes them.

The properest *Lathe* to *Turn* this slender Work is the *Turn-Bench* described § 18. *Plate 16.*

§ XVII.

§ XVII. Of the *Brasiers Lathe and Turning Tools; and their manner of using them.*

Brasiers that Turn Andirons, Pots, Kettles, &c. have their *Lathe* made different from the Common *Turners Lathe*, as you may see in *Plate 16.* at A, where the *Cheeks, Puppets* and *Rest*, &c. are much stronger, and the *Pikes* stronger and longer than those the common *Turners* use. Their *Edge Tools* which they call *Hooks*, are also of a different shape, as the *Figures* of them described at B 1, B 2, B 3. in the said *Plate* shew, as being bent backwards and forwards towards the cutting end, somewhat like an z. And as the common *Turners* work with a round *String* made of Gut, as hath been described *Numb. 10. § 1.* ¶ 14. The *Brasiers* work with a *Flat Leather Thong*, which wrapping close and tight about the *Rowler* of their *Mandrel* commands it the easier and more forcibly about. Their *Thong* runs between the *Cheeks* of the *Lathe*.

The whole *Lathe* and its parts are made so strong because the Matter they Turn being Mettal, is much heavier than Wood, and consequently with forcible coming about, would (if the *Lathe* were sleight) make it tremble, and so spoil the Work; as hath been said before.

The reason why the *Hook* is so turned backwards, and again forwards towards the end, is, that they may the better direct the Edge of it as much below the Horizontal Plain of the *Pikes* as they list, the better (in many cases) to come at the Work: For contrary to Soft Wood, Hard Wood and Ivory *Turners*, they always dip the end of their *Hook* below the *Rest*, that

so the *Hook* resting very steddy upon the *Rest*, and also against one of the Iron *Pins* standing upright in the *Rest*, and held very steddy forwards to the *Work*, the strong coming about of the *Work* against the strong Edge of the *Hook*, scrapes off the extuberant Mettall lying in that Sweep.

I need no further describe the *Lathe*, and other *Tools* that belong to *Brassers* Turning; or more of the manner of using them; because, by the whole preceding Discourse these Arguments are largely and sufficiently handled: especialiy considering I have given you the Figures of them in *Plate 16.* as afore-said.

Only, their way of *Whetting* their *Tools* being different from the *Whetting* of other Turning *Tools*, I shall say somewhat to: For they *Whet* their *Hooks* upon a broad Flat *Slate*, holding the *Hook* almost perpendicular, that the *Basil* of its Edge may comply with the Flat of the *Slate*; with clasping the upper end of the *Handle* in their left hand to lean the heavier on it, and clutching the *Shank* of the *Blade* near the *Hook*-end in the right hand, to guide it: And thus with Spittle or Water rub forwards and backwards on the *Slate*, till they have sharpened the Edge of the *Hook*. But if it be a Round end *Hook* they whet, they chuse a *Groove* in the *Slate* fit to comply with the round edge of the *Hook* (for they have different sized *Grooves* in the *Slate* for that purpose) and so in it rub forwards and backwards as afore-said.

§ XVIII. Of Turning Small Work, of Brass or other Mettal.

Small Work in Mettal is Turned in an Iron Lathe called a *Turn-Bench*. The Figure of it is described in Plate 16. at C. When they use it they screw it in the *Chaps* of a *Vice*, and having fitted their Work upon a small Iron *Axis* with a *Drill-Barrel* fitted upon a square Shank at the end of the *Axis* next the left hand, they with a *Drill-Bow* and *Drill-string* carry it about, as was shewn Numb. I. fol. 6, 7. with this difference, that when a Hole is drill'd in a piece of Mettal, they hold the *Drill-bow* in their Right Hand; but when they Turn Small Work, they hold the *Drill-bow* in their left hand, and with their right hand use the *Tool*, which is commonly a *Graver* or sometimes a *Sculptor*, fit to such Moldings as are to be made on the *Mettal*.

They begin to work first with the sharp point of a *Graver*, laying the Blade of it firm upon the *Rest*, and directing the point to the Work, and lay Circles upon it close to one another, till they have wrought it pretty true: Then with one of the broad Edges of the *Graver* they smoothen down what the Point left, and afterwards with *Sculptors*, *Round* or *Flat*, or great or small, they work their intended Moldings.

The Circumstances and Considerations in the choice of a *Drill-bow* and *Drill-string* for Turning, are the same with what you find Numb. I. fol. 6, 7. for Drilling.

§ XIX. Of laying Moldings either upon Mettal or Wood, without fitting the Work in a Lathe.

I Had soon after the Fire of *London* occasion to lay Moldings upon the Verges of several round and weighty flat pieces of *Brass*: And being at that time by reason of the said Fire unaccommodated of a *Lathe* of my own, I intended to put them out to be *Turned*: But then *Turners* were all full of Employment, which made them so unreasonable in their Prizes, that I was forc'd to contrive this following way to lay Moldings on their Verges.

I provided a strong Iron *Bar* for the *Beam* of a *Sweep*: (for the whole *Tool* marked in *Plate 16*, is by Mathematical *Instrument-makers* called a *Sweep*.) To this *Tool* is filed a *Tooth* of Steel with such *Roundings* and *Hollows* in the bottom of it as I intended to have *Hollows* and *Roundings* upon my Work: For an *Hollow* on the *Tooth*, makes a *Round* upon the Work; and a *Round* upon the *Tooth* makes an *Hollow* on the Work; even as they do in the *Molding Plains* *Joiners* use. Then I placed the *Center-point* of the *Sweep* in a *Center-hole* made in a square *Stud* of *Mettal*, and fixed in the *Center* of the *Plain* of the Work: and removed the *Socket* that rides on the *Beam* of the *Sweep* till the *Tooth* stood just upon its intended place on the *Verge* of the Work, and there screw'd the *Socket* fast to the *Beam*.

To work it out, I employ'd a Labourer, directing him in his left Hand to hold the Head of the *Center-pin*, and with his Right Hand to draw about the *Beam* and *Tooth*, which (according to the strength) he us'd, cut and tore away great Flakes of the *Mettal*, till
it

it receiv'd the whole and perfect Form the *Tooth* would make; which was as compleat a Molding as any Skilful *Turner* could have laid upon it.

Having such good Success upon *Brass*, I improv'd the Invention so, as to make it serve for Wood also. And made a *Plain-Stock* with my intended Molding on the *Sole* of it, and fitted an *Iron* to that *Stock* with the same Molding the *Sole* had.

Through the sides of this *Stock* I fitted an *Iron Beam* to do the Office of the *Beam* I used for the *Sweep*, viz. to keep the *Plain* always at what position I listed from the Center (for thus the *Iron* in the *Plain* wrought about the Center, even as the *Tooth* in the *Sweep* (before rehearsed) and to that purpose I made a round Hole of about half an Inch Diameter near the end of the *Iron*: Then in the Center of the Work I fixed a round *Iron Pin*, exactly to fit the said Round Hole, putting the Round Hole over the *Pin*, and fitting the *Iron* into the *Stock* commodious to work with. I used this *Plain* with both Hands, even as *Joiners* do other *Plains*: For the *Iron Pin* in the Hole of the *Beam* kept it to its due Distance from the Center; so that neither hand was engaged to guide it.

But note, The *Stock* of this *Plain* was not straight (as the *Stocks* of other *Plains* are) but by Hand cut Circular pretty near the size of the Diameter of the intended Molding: And yet was made to slide upon the *Beam*, farther from, or nearer to the Center, as different Diameters of *Verges* might require.

§ XX. To Turn several Globes or Balls of Ivory within one another, with a Solid Ball in the middle.

YOU must first Turn your *Ivory Ball* or *Globe* truly round, of your intended Diameter: Then describe a Circle exactly through the middle or Equinoctial of the *Globe*: Divide that Circle into four equal parts, and pitch one point of a pair of Compasses in one of those Divisions, and extend the other point to either of the next Divisions, and describe with it a Circle round about the *Globe*. Then remove the standing point of the Compasses to either of the next Divisions in the Equinoctial, and in like manner describe another Circle round about the *Globe*.

But note, that the moving Point of your Compasses must be somewhat bended inwards; For else its point will not describe a Circle on the greatest Extuberances of the *Globe*, but will slide off it.

Thus shall the Ball or Globe be divided into eight Spherical Quadrants: Describe as great a Circle as you can in each of these Quadrants, and each two Centers of every two opposite Circles shall have an imaginary *Axis* pass between them: And if the *Globe* be successively pitcht upon all the rest of the Centers, so as the imagined *Axis* passing between it and its opposite Center, lie in a straight line with the *Pike* and the Center of the *Collar* it is Turned in, the working out of all the *Hollows* on the Ball will be but common Turners Work, as you will find hereafter. This is in brief the Theory: But to the Practice. You.

You must use an *Hollow Mandrel*, made fit stiffly to receive the convexity of the *Globe* in its concavity, so as it may stick firmly in the *Mandrel* in its Position: And you must take care that in pitching the *Globe* into the *Mandrel*, that the imaginary *Axis* of the *Globe* (which is the Line passing between the two Centers of the two opposite Circles as aforesaid) lie in a straight Line with the *Axis* of the *Mandrel*; which you may know by examining whether the Circle described with your *Compasses* (as aforesaid) on the Center (aforesaid) wobble not in a whole Revolution of the *Globe* from the point of a Tool applied steadily to it.

Having thus pitcht the *Globe* true, and fixt it fast into the *Mandrel*, you must begin to work with the *Triangular Grooving Point* (described Numb. II. s 5. and Plate 15.) placing the point of it pretty near the Center of the Circle, and work into the *Ball* with the *Grooving Point*, and so by degrees make a Hollow in the *Ball* so deep and so wide as you think convenient, I mean so deep from the Superficies of the *Globe* towards the Center of the *Globe*, and so wide from the Center of the Circle described on the Superficies of the *Globe* towards that Circle, as it may have a convenient Substance between this Hole and the next intended to be *Turned*.

Thus must every one of the eight Circles described on the *Globe* be successively by the same Rule, and after the same manner be pitcht outwards, and fixt into the *Mandrel*, and then Hollowed out as the first was. Where note, that every Hollow is to be *Turned* to the same depth and

width exactly as the first was: Which to do, you must use a *Gage* made of a thin Plate of Iron or Brass, as is described in *Plate 17. Fig. D.* whose two sides from *a* the Bottom of the *Gage*, to *b* the *Shoulder* are the depth of the *Hollow* from the Superficies of the *Globe* towards the Center: *b b.* is the width of the *Hollow* at the Superficies of the *Globe*; and *a a* is the bottom width of the *Hollow*; and the concave Arch between *a a* is an Arch that the Convexity of the little Solid Ball to be Turned within all the *Spheres* must comply with. So that when each *Hollow* is Turned, the *Gage* must be put into it to try how the sides of the *Hollow* complies with the sides of the *Gage*, and also how the Arch in the bottom of the *Gage* complies with the surface of the Solid Ball in the middle.

Having thus Turned all the *Hollows* in the *Globe*, you must provide several thin and narrow Arching *Grooving Tools*, whose convex and concave Arches comply both with the Convexity and Concavity of each *Globe* or *Sphere* to be Turned within the outermost: So that beginning at the Bottom of the *Hollow*, you Turn just half way of the Solid Ball loose from the *Sphere* it is contained in, viz. as far as the Equinoctial of the *Globe*; and in thus Turning it, you must take great care, that the Solid Ball on its Convexity and the Concavity of the *Sphere* it is contained in, be both at the same time Turned exactly Spherical.

Thus one half of the Solid Ball being Turned loose, you may in like manner Turn the next *Sphere* it is included in half loose also: And so successively as many *Spheres* as you list.

Having

Having thus *Turned* one half of all the *Spheres* loose, you must take the whole *Globe* out of the *Hollow Mandrel*, and pitch and fix the *Globe* again into the *Mandrel*, so as the imagined *Axis* of the *Hollow* opposite to the last loosened *Hollow* lie in a straight line (as before was taught) with the *Pike* and *Center* of the *Coller* the *Mandrel* runs in, and then *Turn* the other half of the *Solid Ball* and *Spheres* also loose, as the first half was *Turned*.

§ XXI. To Turn a *Globe* with several loose *Spheres* in it, and a *Solid Cube* or *Dy* in the middle of it.

THis is *Turned* after the same manner the former *Ball* was *Turned*; only instead of dividing the *Equinoctial* of that *Globe* into four equal parts, the *Equinoctial* of this must be divided but into three *Equal* parts, and their *Semi-Circle* drawn through the divisions into either *Pole* of the *Globe*: So shall the *Globe* be divided into six equal parts or *Segments*; in each of which parts must be described a *Circle*, as was described before in the *Globes* of eight equal parts; and in these six *Circles* must be made six *Hollows*, as before there was eight: But instead of working the *Bottom* of each *Hollow* *Spherical*, now the *Bottom* must be wrought *Flat*: So shall the *Cube* when these six *Hollows* are thus made, be formed: and the *Hollows* being exactly of the same depth, and flat in the *Bottom*, the *Cube* or *Dy* will loosen, and each of the six *Flats* in the *Bottom* will become the six sides or *Faces* of the *Cube*.

The manner of loosning all the other inward *Spheres* is as the Former: Only, that was loosned with twice pitching the *Ball* in the *Mandrel*, because the Centers of the *Hollows* lay opposite to one another; But to loosen this *Ball* will require three Pitchings into the *Mandrel*; because the Centers lie not opposite to one another.

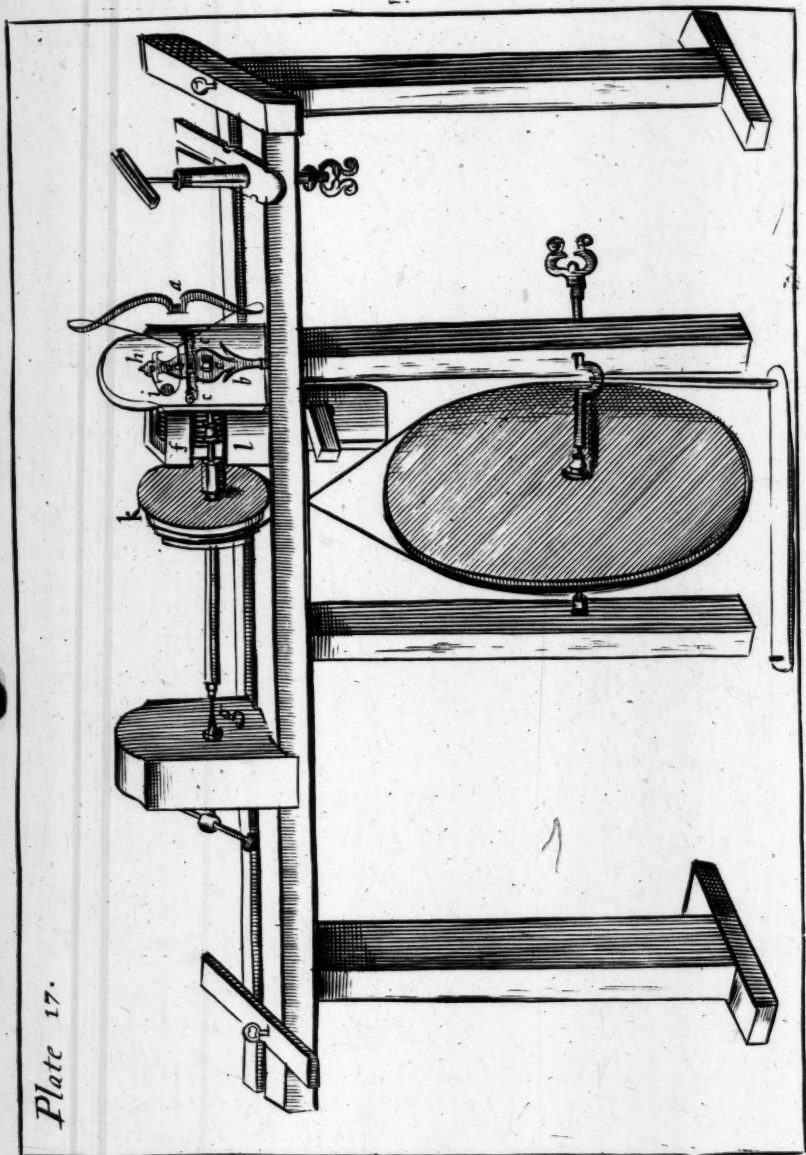
§ XXII. To Turn a Cube or Dy in an Hollow Globe, that shall have but one Hole on the outside to work at.

THE Outside of this *Globe* must be Turned Round, viz. Spherical, as the former, and fixed in an Hollow *Socket* (as before hath been taught) Then must an Hole be Turned in the *Globe* so deep and so wide as you please, as in the Former *Globes*, and the Bottom of that Hole Turned Flat, for one side or Face of the *Cube* or *Dy*: Then with a Semi-circular Tool loosen the whole Core or middle of the *Ball*, and pitch the Core with the point opposite to the Center of the already Flatted Face of the *Dy* outwards against the Hole in the *Globe*, and so fasten it in this position, by pouring in some melted Hard Wax or other Cement; and then with a Flat Tool Turn the Foreside (viz. the side opposite to the first side) flat also. Which done, loosen it out of the Wax, and successively pitch the other sides to be Turned Flat carefully against the Hole, so as all the sides have Right Angles to each other, and fastning them with Wax or Cement (as before) Turn them by the same Rule flat also.

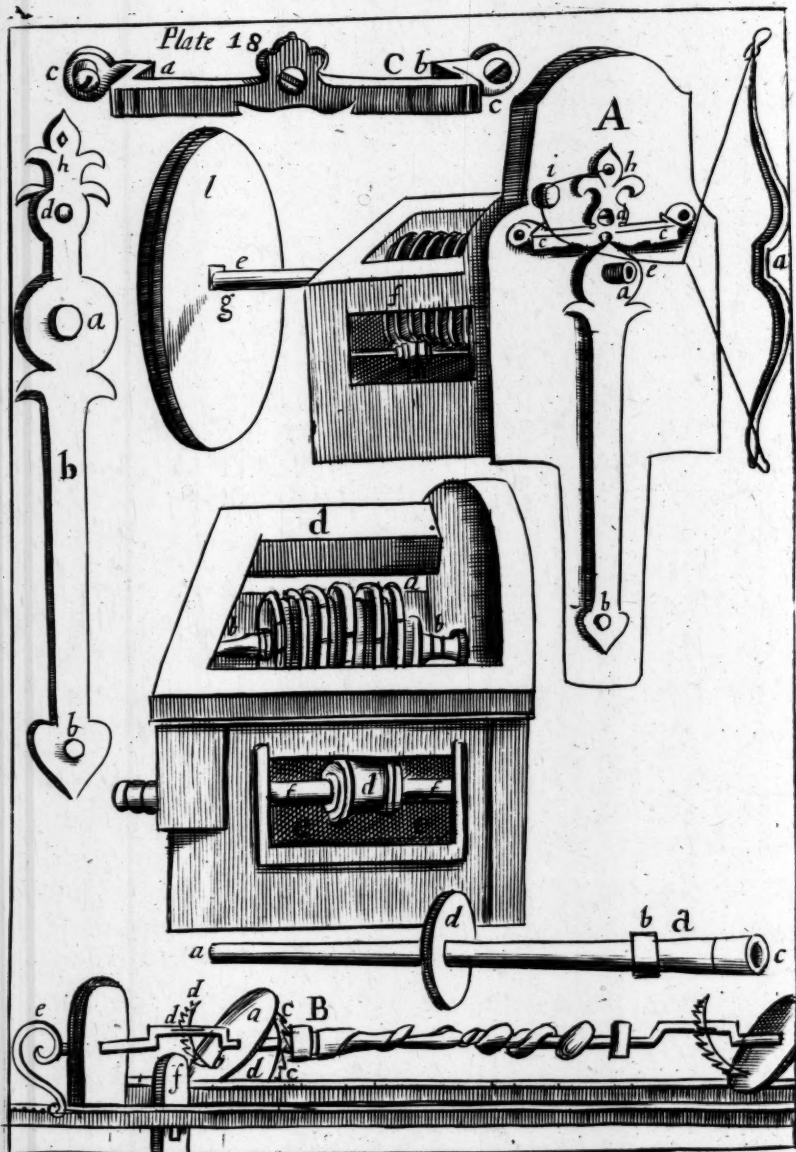
Now

Nöw to make this Thing more admirable to the ignorant Spectator, you may make the *Dy* as big as you can, and the Hole you Turn it at as little as you can; that it may the more puzzle the Wit of the Enquirer to find how so great a *Dy* should have Entrance at a small Hole, unless the Hollow Ball were Turned in two Halves, &c.

Plate 17.







Numb. XIV.
MECHANICK
EXERCISES,
OR
The Doctrine of
Handy-Works.

Applied to the Art of TURNING.

By *Joseph Moxon*, Member of the *Royal Society*, and *Hydrographer* to the
Kings most Excellent Majesty.



LONDON,

Printed for *Joseph Moxon* at the Sign of *Atlas* on *Lucy-gate-Hill*, 1680.

IX

101

3

MECHANICK EXERCISES,

O R,

The Doctrine of

Handy-works,

Applied to the Art of TURNING.

s XXIII. Of Turning Oval Work.

THIS Work may be perform'd in the Common *Lathe* that goes either with the *Treddle Wheel* or the great Wheel; because the Work must run always one way, if the *Puppet* be made to it with the Machination described in *Plate 17.* and an Iron *Axis* be made to carry the Work about, and to its end be fitted and fastned a *Brass Collar* with a Female Screw in it, to screw on the *Mandrel* that the Work you intend to Turn is fixt upon.

To the Foreside of this *Puppet* is fastned at *b* as on a Center-pin a strong Iron *Collar* marked *b h*, and this *Collar* is called the *Moving-Collar*; because it moves between the Iron *Shackle c c* and the Fore side of the *Puppet*. Into this *Moving Collar* is fitted the *Hollow Axis* marked *c*, so as to turn round in it as if it were in any of the other *Collars* formerly described; but the *Moving Collar* moving between the

K k

Shackles

Shackles and the Fore-side of the *Puppet* carries the *Hollow Axis* with it athwart the *Puppet*, even so far as is the width of the *Hollow* between the *Shackle* and the Fore-side of the *Puppet*. And thus by the moving of the *Hollow Axis* backwards and forwards the Work screwed in it, having an *Edg'd* or a *Pointed Tool* applied to it receives that *Oval Form* which is made upon the *Guide*.

But to make it move thus to and from you, there are required several Machinal Helps: For there is a strong *Steel Bow* as at a fastned about its middle part to the further side of the *Puppet*, which stands about an Inch forwarder than the Fore side of the *Puppet* with its hollow side to the Workman. And to the ends of this *Steel Bow* is fastned a strong *String* of Gut, and to the middle of that *String* in a Noos is fastned another strong *Gut-string* with a Noos at its end. This last mentioned *String* is made exactly of that length that when the nearest side of the *Guide*, viz. its least Diameter is set into the *Groove* of the *Guide-pulley*, and the *Bow* is strained, and this *String* laid in the *Groove* of the *String-pulley*, the Noos at the end of it may be put over the *Iron Button* fixed in the top of the *Moving-Collar*. For then as the *Treddle-Wheel* carries the *Axis* about, the *Guide* being firmly fastned upon the *Axis* comes also about; and having the *Groove* of the *Guide-pulley* set against the outer edge of the *Guide*, as the great Diameter of the *Guide* is turned against the *Guide-pulley*, the *Moving-Collar* being drawn by the strength of the *Bow*, draws the *Hollow Axis* along with it, as also the Work screwed in the *Hollow Axis*: And thus as the small Diameter of the *Guide* comes to the *Guide-pulley*, the small Diameter of the Work is Formed; and as the great
Diamete-

Diameter of the *Guide* comes to the *Guide-pulley*, the great Diameter of the Work is formed.

This is the Sum of *Oval Turning*.

But that the whole Machine may be yet better understood, I shall more particularly give you the names of all its parts, together with a Description upon its most material parts, where the *Fore-Puppet* is more largely delineated in *Plate 18* at *A*, where also some of the Members most difficult to be described are drawn more at large by themselves.

a The *Bow*.

b The *Moving Collar*.

c c The *Socket* in which the *Collar* is moved.

d The *Stop-screw*, to take out when the *Hollow Axis* moves in the *Moving Collar*.

e The *Hollow Axis*.

f The *Head*, in which is contained the several *Guides*:

g The *Center Head*

h The *Button*.

i The *String-pulley*.

k The *Wheel-pulley*.

l The *Guide-pulley*.

¶ 1. Of the *Hollow Axis* and its *Shank*, marked *a* in *Plate 18*.

THE *Shank* is a Bar of Iron about an Inch thick, and two Foot long, having in its further end a Center-hole to pitch upon the *Pike* in the further *Puppet*; but its hither end is made square to fit tight into a square *Socket* in the *Brass Hollow Axis*: And when it is thus fitted into the hither end of the

Brass, it is Turned true Cilindrically round, so as to fit into the round Hole in the *Moving Collar*. The Diameter of the Round is about two Inches, and the length about two Inches straight; but then a Shoulder is Turned to the Brass Cilinder, to stop it from slipping through the *Moving Center*. In the Fore-end of this *Hollow-Axis* (*viz.* in the Brass Cilinder) is Turned a wide Hole about an Inch and a quarter Diameter, and an Inch deep: And in this wide Hole is Turned a Female Screw with a coarse Thred, to receive a Male Screw made behind the *Mandrel* that the Work is fixed upon.

About the middle of this Iron *Shank* is placed a *Pulley* made of Wainscot Board, about eight Inches Diameter, and an Inch thick, with a *Groove* on its outer edge about half an Inch wide, and half an Inch deep for the *String* of the *Treddle Wheel* that carries the *Axis* about to run in: And between this *Pulley* you may (if you will) have several lengths of such *Male-screws* as was described *Numb. II. § 6. ¶ 4.* and *Plate 15.* to make Screws with, if you please.

See the Figure *a d c b*, disjunct from the rest of the Work.

a The hinder end.

d The Pulley of the *Axis*, or *Wheel-pulley*.

c The Hollow or Hole in the Fore-end of the *Hollow Axis*.

b The Shoulder of the *Hollow Axis*.

¶ 2. Of the *Moving Collar* marked *b* in *Plate 18*.

THis whole Member is called the *Moving Collar*, though the *Collar* strictly is only the round Hole at *a*, into which the *Hollow Axis* is fitted. It is made of

of Iron to reach from its top at *b* (the *Button*) down to the bottom of the *Cheeks* of the *Latke*, as at *b*; upon which Pin (as on a *Center*) the whole *Moving Collar* moves backwards and forwards; its extreme Breadth is about three Inches, and its thickness above a quarter of an Inch. Its Neck at *c* is clasped but not fixed down to the Fore-side of the *Puppet*; for this Neck is only gaged in the *Shackle* marked *c*, so as the Neck (and consequently the whole *Moving Collar*) may slide from end to end of the *Shackle* forwards and backwards. *d* A small *Female Screw*, into which through a Hole in the *Shackle* is fitted a *Male Screw* to hold the *Moving Collar* and the *Shackle* together, that the *Moving Collar* may not move when only round Work is Turned in the *Collar*.

¶ 3. Of the Fore-side of the *Puppet*, and the *Shackle* marked *c*.

Under this *Shackle* (*viz.* between it and the Fore-side of the *Puppet*) moves the Neck of the *Sliding Collar* from *a* to *b*, when the ends at *c c* are fixed down to the Fore-side of the *Puppet* with two Iron Screws.

¶ 4. Of the Hollow in the *Puppet* marked *d*.

IN the middle of the *Puppet* is hollowed out a Hole about three Inches between the Fore and Backside of the *Puppet*, and four Inches athwart the *Cheeks* in the *Puppet*, and four Inches deep: So that about an Inch of Substance remains on each of the four upright sides. But the Top is quite open. (as at *a*) Through the middle of this square Hole runs the Iron *Axis*

marked *b b*, on which is fixed the several *Guides* that are to be used in this sort of Working.

It is open at the Top, that *Light* may be let in to set the *Guide-pulley* to which *Guide* you please, and it is open on the hither side as at *e e* about an Inch and an half above and below the *Axis*, that the *Guide-pulley* may be slid on its *Axis* to any of the *Guides*.

The *Guide-pulley* marked *d* is a Brass Pulley of about an Inch Diameter, and a little above a quarter of an Inch thick, having a *Groove* in the Edge of it to receive the Edge of the *Guide*. It hath in its middle a round Hole about half an Inch Diameter, which round Hole slips over a round Iron *Pin* of the same Diameter, marked *f f*, so as it may slide from one end of the said Iron *Pin* to the other, according as the *Guides* may be fixed towards either end.

When it is used, the *Groove* in the Edge of this *Guide-pulley* is set against the Edge of the *Guide*, and being fitted tight on the round Iron *Pin* aforesaid, and the two ends of the Iron *Pin* fast fixed into the Wood of the *Puppet*, the *Guide-pulley* may indeed move round on the Iron *Pin*; but the strength of the Iron *Pin*, and *Guide-pulley* will resist the extuberick parts of the Edge of the *Guide*; and so with the assistance of the strength of the *Steel Bow* force the *Guide* and *Hollow Axis* to move backwards; and then an *Edge-Tool* held to the Work in the *Mandrel* screwed in the *Hollow Axis* will describe the same Figure on the Work as is on the outer Edge of the *Guide*.

Note, that when you are at Work, you must keep the Hole in the middle of the *Guide-pulley* well oyl'd,

as also the round Iron Pin it slides and turns round upon; because this *Guide-pulley* ought to run round: For then the *Axis* will have an easier and swifter motion, though it may indeed perform the Work if it run not round upon the Iron Pin.

§ XXIV. Of Rose-Work, &c.

Rose-Work Turning, or Works of any other Figure, are performed by the same Rule and after the same manner as *Oval Work* is made; only by changing the *Guides*, and using one whose outer Edge is made with the Figure, or several Figures you intend to have on your Work.

§ XXV. Of Turning Swash-Work.

TO the Turning of *Swash-Work* you must have two such *Puppets* as the *Fore-puppet* described in § 22. And also a Round *Swash-board*, about ten Inches Diameter, and an Inch and an half thick, as is *a* in Fig. B. Plate 18. Upon both the Flat sides of this *Swash Board* in a Diametrical Line is fastned upright an Arch of a Quadrant made of a Steel Plate, about half a quarter of an Inch thick, and an Inch and a quarter broad, as at *b b*, *c c*. The convex edges of these Quadrants are cut into Notches, like the Teeth of an Hand-Saw; that according as you may have occasion to set the *Swash-Board* more or less a slope, you may be accommodated with a Notch or Tooth to set it at. This *Swash-Board* hath an Hole made about its Center, to slip over the *Iron Axis*: And being thus slipt over the *Iron Axis*, you set it to that Slope you intend the *Swash* on your Work shall

shall have. And to fix it fast in this position, you must put the Blades of the Quadrants into two *Slits* made in the *Iron Axis* as at *d d*, and fit the two opposite Teeth against the two outer Shoulders of the *Slits*.

You must moreover make two strong *Steel Springs* as at *c c*, to reach from the bottom of the outer sides of the *Puppets*, being strong nailed, or rather screwed down there, which must reach up so high as the *Axis*. And in the inner sides of these *Springs* must be made two Center holes for the points of the *Axis* to be fitted in: For the *Oval-Guide* being fitted to one end of the *Axis*, and a *Low-Puppet*, as at *f*, wedged close to one side of the *Swash-Board*, when the *Swash-Board* stands in its greatest declivity; Then in a Revolution of the *Axis*, as the farther part of the Circumference of the *Swash-board* comes to the *Low-Puppet*, one *Spring* will be forced backwards, and the other will spring forwards; and an *Edg'd-Tool* held against the *Work* fixed on the *Axis*, will make on the *Work* the Form of a *Swash*, &c.

These *Oval-Engines*, *Swash-Engines*, and all other *Engines*, are excellently well made by Mr. *Thomas Oldfield*, at the sign of the *Flower-de-luce*, near the *Savoy* in the *Strand*, *London*.

Thus much of *Turning*: My next *Exercises* will (God willing) be upon the Art of *Printing*.

An

*An Explanation of Terms used in these
Exercises of Turning, Alphabetically
digisted.*

A.

AXIS. The imagined straight Line that passes through the two Center-points that Turned Work is Turned upon. Thus the imagined Line that passes between the two Pikes through the Work in the Lathe is the Axis. |

B.

BOW. The Bow that Common Turners use is described Numb. 10. § 1. ¶ 11. And the Bow that Oval Turners use is described Numb. 14. § 23. and Plate 17, 18. at *a*.

Button. The Button is described Numb. 14. § 23. and Plate 17. at *b*.

C.

CALLIPPERS. Compasses with bowed shanks to measure the Diameter of any round Body. See Numb. 12. § 11. and Plate 14. at *O*.

Center-Head. See Numb. 14. § 23. and Plate 17. at *g*.

Cheeks. See Numb. 10. § 1. ¶ 2. and Plate 12. *b b*.

Chock. See Numb. 11. § 6. ¶ 5. and Plate 13. at *F* 5. *a*.

Cleaving-knife. See Numb. 12. § 9. and Plate 13. at M.

Cránk. The end of an Iron Axis turned Square down, and again turned Square to the first turning down, so that on the last turning down a Leather Thong is slip't, to Tread the Treddle-wheel about.

Collar. See Numb. 11. § 7. and Plate 13. at G-H-I.

Crook. See *Crank*.

Cross-Treddie. See Numb. 10. § 1. ¶ 8. and Plate 12. at k.

D.

D*ril-Barrel.* See Numb. 1. Fol. 6. Plate 1. and Fig. 8. at C.

Drill-Bench. See Numb. 12. § 12. Plate 14. at a a a a.

Drill-Bow. See Numb. 1. Fol. 6, 7.

F.

F*emale Screw.* The Screw made in the round Hole of a Nut.

Flat-Chissel. See Numb. 11. § 3. and Plate 15. at C C.

Flat-Mandrel. See Numb. 11. § 6. and Plate 13. at F 1.

G.

G*ouge.* See Numb. 10. § 2. ¶ 1. and Plate 15. at B B.

Great Wheel. See Numb. 10. § 1. ¶ 12. and Plate 14. at a.

Grooving Hooks. See Numb. 11. § 5. and Plate 15. at E.

Grooving Tools. See *Grooving Hooks*.

Guide. See Numb. 14. § 23. ¶ 4. and *Plate* 18.

Guide-Pulley. See Numb. 14. § 23. ¶ 4. and *Plate* 18.
at *d*.

H.

H*ead.* See Numb. 14. § 23. and *Plate* 17. at *f*.
Hook. See Numb. 13. § 17. and *Plate* 16. at B 1.
B 2. B 3.

Hollow Axis. See Numb. 17. § 17. and *Plate* 17. at *e*.

Hollow Mandrel. See Numb. 11. § 6. ¶ 3. and *Plate*
13. at F 3.

I.

J*oynt Collar.* See Numb. 11. § 7. and *Plate* 13.
at G.

L.

L*athe.* See Numb. 10. § 1. and *Plate* 12.
Legs. See Numb. 10. § 1. and *Plate* 12. at *aaaa*.

M.

M*andrel.* See Numb. 11. § 6. ¶ 1. and *Plate* 13.
at F 1. F 2. F 3. F 4.

Mawl. See Numb. 12. § 8. and *Plate* 13. at K.

Male-Screw. The Screw made upon a Shank or Pin.

Moving Collar. See Numb. 14. § 23. ¶ 2. and *Plate*
18. at *b*.

N.

N*UT.* A piece of Iron that a Female Screw is
made in.

P.

Pike. See Numb. 10. § 1. ¶ 5. and *Plate 12.*

Pin-Mandrel. See Numb. 11. § 6. ¶ 2. and *Plate 13.* at F 2.

Pole. See Numb. 10. § 1. ¶ 9. and *Plate 12.* at l.

Puppet. See Numb. 10. § 1. ¶ 3. and *Plate 12.* at c c.

R.

Reft. See Numb. 10. § 1. ¶ 6. and *Plate 12.* at e.

Rowler. See Numb. 11. § 6. and *Plate 13.* F 1. at b.

S.

Screw-Mandrel. See Numb. 11. § 6. ¶ 4. and *Plate 13.* at F 4.

Seat. See Numb. 10. § 1. ¶ 15.

Shackles. See Numb. 14. § 23. ¶ 2. and *Plate 18.* V at c c.

Side-Reft. See Numb. 10. § 1. ¶ 7. and *Plate 13.* at e.

Socket. See *Chock.*

Steel-Bow. See Numb. 14. § 23. and *Plate 18.* at a.

Stop-Screw. See Numb. 14. § 23. and *Plate 17.* at d.

String. See Numb. 10. § 1. and *Plate 12.* at m.

String-Pulley. See Numb. 14. § 23. and *Plate 17.* at i.

Swash. A *Swash* is a Figure whose Circumference is not Round, but Oval; and whose Moldings lye not at Right Angles, but Oblique to the *Axis* of the Work. See Numb. 14. § 25. and *Plate 18.* at Fig. B.

Swash-Board. See Numb. 14. § 25. and *Plate 18.* at a in Fig. B.

Sweep.

Sweep. See Numb. 13. § 19. and *Plate* 16. at D.

T.

T*Read.* See Numb. 12. § 13. Fol. 209.

Treddle. See Numb. 10. § 1. and *Plate* 12. at i.

Treddle-Wheel. See Numb. 10. § 1, ¶ 13.

Turn-Bench. See Numb. 13. § 18. and *Plate* 16. at C.

W.

W*Abble.* When a piece of Work is not pitch true upon its Centers, it will in a Revolution incline more on one side of its Circumference than on its opposite side. See Numb. 14. § 23. and *Plate* 17. at k.

There are several other Terms used in these *Exercises* of *Turning* not explain'd here: But because they are used in some of the former *Exercises*, and there explain'd, I shall refer you to them.

The End of the First Volume.
